



DAFFODILS

From the Water-Colour Drawing by Beatrice Parsons

THE WAVERLEY
NATURE BOOK

*A POPULAR DESCRIPTION BY PEN AND
CAMERA OF THE DELIGHTS AND
BEAUTIES OF THE OPEN AIR*



VOLUME V

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A GROUP OF PUFFINS.

A SEA-BIRD NURSERY

Some interesting facts on the domestic life of Sea-birds

By A. J. R. ROBERTS, B.A.

Illustrated with Photographs by the Author

FAR back in the ages when the earth was void, and without form, the elemental wind swept over the heaving waste of waters, stirring them to their depths. On every wave there rode a crest of gleaming white, and the wind caught them up, tossed them hither and thither and breathed life into them. For the sea had responded to the touch of her rude lover, and the children of that embrace were the sea-fowl—wild, restless and elemental as the forces which begat them. Born of the sea, to be the playthings of the wind, they partake in greater or lesser degree of the nature of one or the other parent. Some, long and lever-winged, light as foam and strong as the storm, have made their home in the air, wheeling, soaring, gliding

and wheeling again hour after hour, day after day, living, feeding, and, who shall say, perhaps sleeping, on the wing. Others, boat-like in build, with breast-bone thickened to form a keel and wings short and narrow to serve as paddles under water, spend their life on the ocean following the wandering shoals of fish far out of sight of land and out-matching them in their own element.

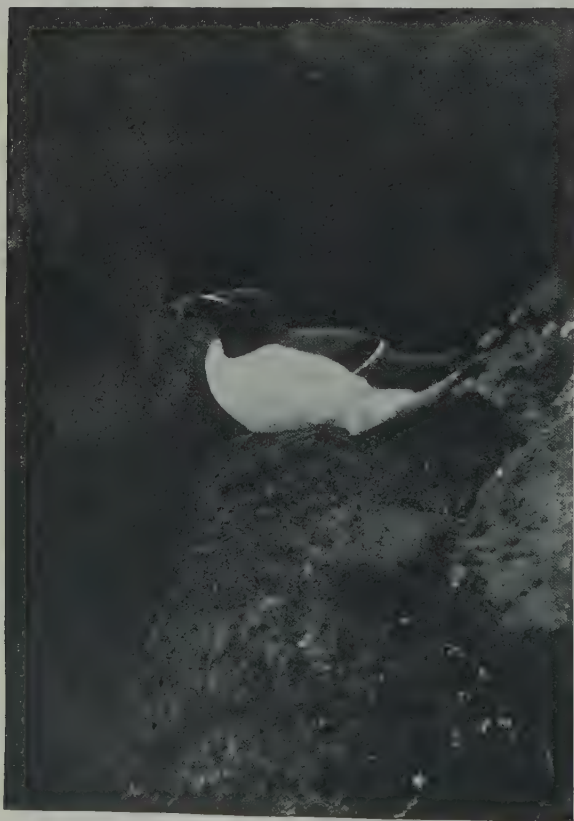
Such are the sea-birds for nine months in the year, but they cannot quite dispense with land. Regularly as the seasons, the instinct stirs within them to propagate their own species, and in obedience to the call they journey hundreds of miles unerringly across the trackless ocean, guided by some unknown compass back to the nursery where they, too, were born.

Towards the middle of May you see them streaming in from every hand, dropping exhausted on the cliff-ledges, the boulder-strewn slopes and the stack rocks, till the earth seems covered, the sea dotted, and the air teeming with countless birds. And still they come—snowstorms of kittiwakes, the puffin with his gaudy wedding beak, the grunting razorbill, the snake-necked guillemot, the petrels and shearwaters, the cormorants back to the stench and swelter of their nests, and the hordes of thieving gulls—herring, greater and lesser black-backed—to take toll of their eggs, the hawk of their lives, and the skua to claim tithes of their fishing.

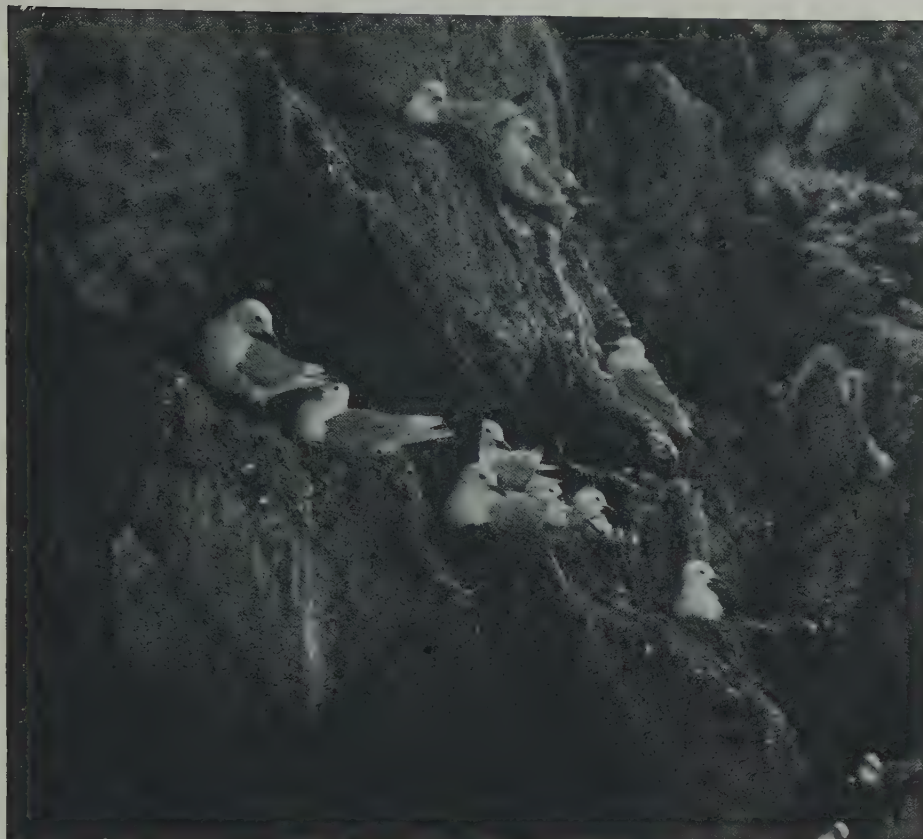
The nursery is generally some inaccessible sea-girt precipice, broken here and there by steep grass-grown slopes, piles of huge boulders affording numberless holes, nooks and crannies—ready-made burrows for the razorbills and

puffins. The guillemots line the narrow ledges on the very face of the cliff, laying their solitary egg in places where destruction seems to threaten it every instant, or mass together on the broader benches and the summits of the stack rocks. The kittiwakes form a colony apart, taking advantage of any slight irregularity in the surface of the rock to affix their nest, almost as does the house-martin against a sheer wall. Bits of seaweed, grasses and straws are trodden down and cemented by slime and mud brought up on the birds' feet, till the nest becomes one solid mass adhering firmly to the rock; and there they brood high above the warring of the waves, like so many sculptured saints in natural niches, drowning the monotonous roar of the surf by their incessant wailing cries. Drop a stone over the cliff-side, and immediately the birds sail forth in a dense body on extended wing, then, quickly recovering from their fright they check themselves with much beating of wings, and the pearly grey cloud dissolves into a thousand shimmering units, whirling, rising and falling like an eddy of snowflakes, whilst from every throat there comes the indignant scream "Kitti-wa-ake, kitti-wa-ake!"

Gradually the storm subsides and the birds return to their nests, for they do not willingly quit them for long. Only too well do they know that their larger relatives are more to be feared than any human being, and such is the boldness and greed of the herring and lesser black-backed gulls that I have often seen them swoop down upon some unguarded nest within fifteen yards of me, and, driving their powerful beaks through an egg, carry off their booty to devour at leisure on some dizzy height. To this the photographer owes his opportunity. Creeping from ledge to ledge along the face of the cliff, avoiding any quick or sudden movement, it is not hard to



MALE RAZORBILL.



A CLUSTER OF KITTIWAKES.

obtain a picture, setting up the camera some six feet from the bird.

So, too, may he stalk the guillemot; for to the winged poacher the relatively enormous egg is, if anything, a still greater prize. It is intensely interesting to watch these birds from so close a distance that one thinks to read their changing moods in the piercing black eye. No greater contrast to the dainty lover-like kittiwake could well be imagined. Watch them as they sit in rows with white breast turned to the cliff so that their drab-coloured backs may render them less conspicuous to enemies from the sea, craning their snake-like necks this way and that, eyeing you now from one side now from the other, curious of their neighbours' affairs, anxious yet reluctant to go, and you will begin to recast your ideas on the possibilities of bird anatomy and perpetual motion.

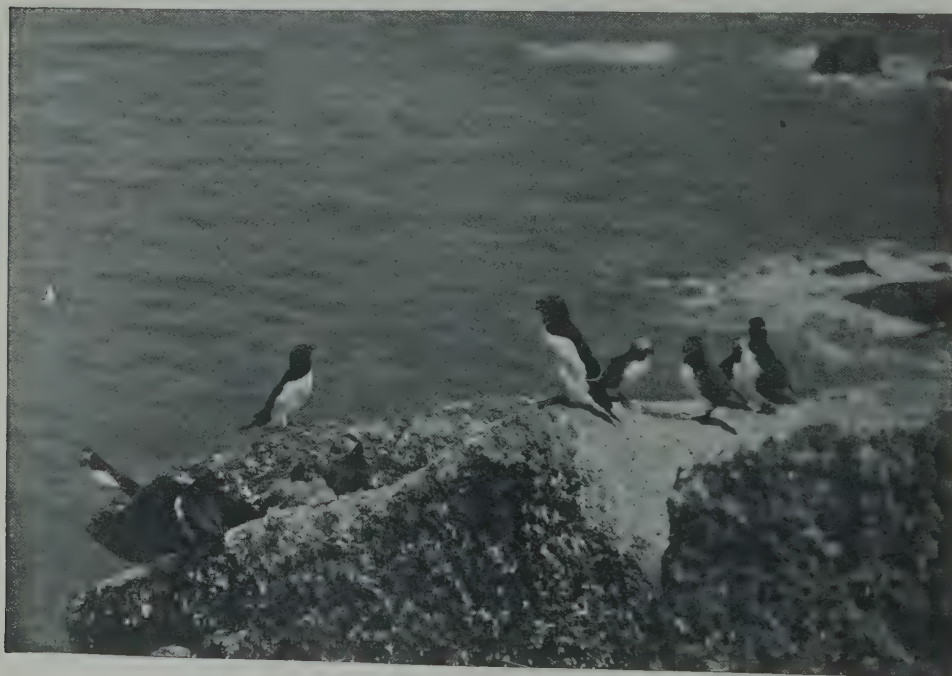
The one fixed point is where the body touches the egg, for the female plucks a patch bare of feathers between the thighs so as to bring the greatest heat to bear on incubation, and sits astraddle with the egg between her feet. The egg is deep blue, cream or even white in ground colour, blotched, streaked or scribbled over with bold black markings. No two are alike, but all are pear-shaped—a provision which causes them to roll in a circle when set in motion, though often the ledges are not sufficiently wide to admit of this manoeuvre. Numbers are destroyed by sudden gusts of wind, and yet more are literally kicked off by the birds themselves when, suddenly alarmed, they attempt to leave in a hurry, and break with a sickening hollow squelch on the rocks perhaps two hundred feet below.

The guillemot is reputed to be a some-

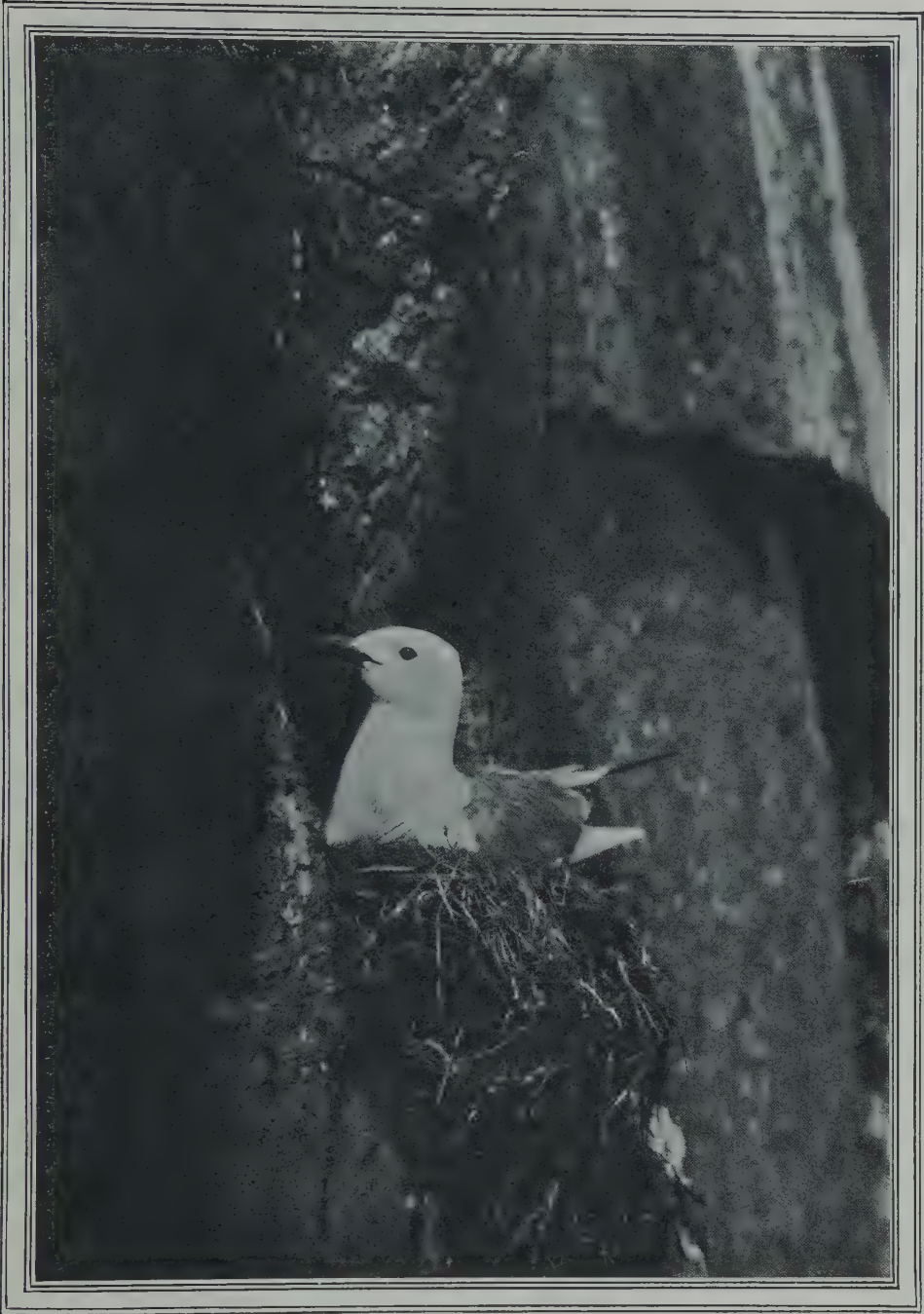
what silent bird, and it is this silence, combined with the constant restlessness, that heightens the almost uncanny impression it leaves upon one's mind. Yet when they are collected in vast numbers on some stack rock there is a continuous murmuring hubbub, rising sometimes, and especially at night, to a clangorous roar—like the ground sea, a prelude to a change in the weather.

Returning to the summit of the cliffs one steps into a new world. All is warmth and sunlight, and one gives a slight shudder—a relic of the damp, cool precipices, the cavernous gullies still lying in the shadow. But all is life, too. Hosts of puffins and razorbills bask on the sunny boulders; they crawl forth from their burrows; the air is alive with a stream of birds flying in one vast circle—the constitutional exercise of the puffin city. Some are constantly dropping out, others rise to fill the gaps, and so the stream flows on. Many return from the sea with four or five small fish held crosswise in the beak, heads and tails dangling on either side; others wing their way to the fishing-grounds, and one's eye

follows them to the water only to see innumerable specks of black and white bobbing up and down on the waves. Nay, more! Here and there one can see a shadowy form beneath the water, cleaving its way, doubtless, through some shoal of tiny fish; and few, indeed, escape that once feel the pressure of that beak. The profusion of life is bewildering. The birds are all about you as you sit half concealed among the boulders, each apparently the exact counterpart of the other. Then suddenly it flashes upon you that each has its own individuality, thinks its own thoughts, lives its own life. Differences too slight to catch the human eye are all apparent to them—else how account for their behaviour? Half a dozen birds close at hand are basking peacefully in the sunlight. Another joins them; there is plenty of room on that enormous boulder, but seemingly he is not a friend. Instantly a fight ensues. Two birds seize each other with their curious beaks and strain and struggle for mastery, preserving the while the most ludicrous gravity and perfect silence, till one or both fall over the edge and disappear from view.



RAZORBILLS AND PUFFINS.



KITTIWAKE AT HOME

Wonderful that they can find their own nesting hole in that wilderness of tumbled stone; wonderful that they can recognise their mate amongst the teeming throng; more wonderful still that they should distinguish friend and foe—unless the organisation of the puffin city is greater than we suspect. What if the birds nesting in one small area consorted together like neighbours in one street? Then perhaps were the riddle solved.

Yet teeming as the life of the nursery is, it must be as nothing compared with the infinite resources of the sea. All these birds and their young have to be fed for nearly three months on fish caught in the immediate neighbourhood. The cormorant is said to eat considerably more than its own weight of fish every day, and it is certain that puffins, razor-bills and guillemots are not far behind. One hesitates to commit oneself to figures, but in some nurseries there are tens of thousands of birds, and the fish mortality during the breeding season must amount to many millions. Yet one rarely sees the birds in any quantity more than five miles from their breeding quarters.

Stragglers, indeed, may be found perhaps twice that distance, but the time required to make the journey is prohibitive when there is a hungry young one waiting in the burrow. The puffin

is not an expert flier, nor, indeed, are any of the diving sea-birds. The wings have been reduced to a minimum to allow of their being used in swimming under water, and they often experience a difficulty in rising from a calm sea. With head invariably turned to whatever breeze there is, they flap their way over the water like a frightened domestic duck, and then taking advantage of some tiny wavelet they launch into the air. Then their weight gives them momentum, and they travel at a great pace, making a bee-line for their home. The densest fog causes them no difficulty, though how they take their bearings it is impossible to say. I know one old skipper who steered by their flight against the reading of his compass, and it was not till afterwards that he discovered that the needle was affected by a quantity of iron lying close by on deck.

Then when all the labour of rearing the young is over, they are taken down to the water to receive their education, and, if the parent birds have any power of thought, anxiously indeed must they watch the sky lest in the stress of the gale their weakly young ones are drowned. It is Nature's redressing of the balance, the safeguard against the exhaustion of the food supply, and the relentless ocean taking toll for the harvest it yields.

A. J. R. ROBERTS.

VEGETABLE GALLS

WHAT THEY ARE AND HOW THEY ORIGINATE

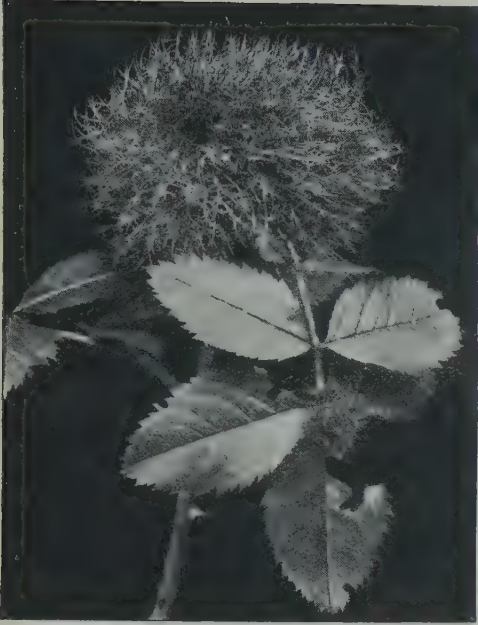
By HAROLD BASTIN

With Photographs by the Author

BY an appeal to the "life history" of the oak-apple Gall-fly, I was able, in a previous paper (p. 693), to show that galls are the direct outcome of insect activity exerted upon the highly sensitive meristem tissue of plants; also, that galls are, in effect, nurseries wherein the earlier stages of the insects are passed

in comfort and security. Moreover, we had a glimpse of that amazing phenomenon known as "alternation of generation." But lest the reader should assume that this phenomenon is characteristic of Gall-fly life as a whole, I must enter upon a brief explanation.

Gall-flies must surely be classed among

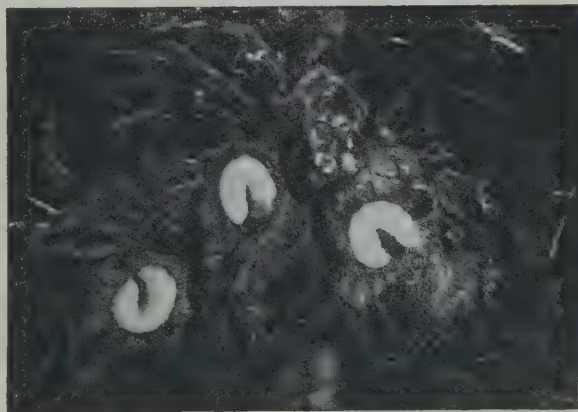


"BEDEGUAR," OR "ROBIN'S PINCUSHION"
OF ROSE.

the most perplexing of all insects from the standpoint of the student. Quite a number of kinds, especially of the numerous species which are associated with the oak tree, have two alternating generations in the course of each twelve months—each generation differing from the one which preceded it, and emerging from a different kind of gall. Moreover, one of these generations is agamic (*i.e.* made up of solitary females capable of virgin reproduction), while the other is sexual, comprising both males and females. These facts were not known to the early naturalists, who gave the insect which emerged from each kind of gall a different name. For example, the wingless agamic female which is bred in the small root galls of the oak was called *Biorhiza aptera*, while her direct offspring (the flies which emerge from the "oak apple") had the name *Biorhiza terminalis* given to them. In order to avoid heaping confusion upon confusion, these separate names are still retained by most writers; but until the

tyro fully grasps the facts of the case, this use of one name for the "mother" and another name for the "child" is apt to be very perplexing. Further, the fact that the phenomenon of alternating generations is not exhibited by *all* Gall-flies does not tend to simplify matters. Quite a number of species have only one generation, or brood, in the course of each year, and in such cases the life cycle is usually quite in accord with that of an ordinary insect. Both sexes are represented, the offspring resemble their parents, and only one kind of gall is produced from year to year.

As examples of these "one generation" Gall-flies I may mention three kinds whose galls are commonly found upon the leaves of wild-rose bushes. These galls differ much in appearance, and this is probably because the grubs attack the cell tissue in distinct ways. First there is the familiar "bedeguar" or "robin's pincushion," formed by an insect known as *Rhodites rosæ*. This gall is a kind of community, being made up of a number of cells, each of which contains a grub. It often appears to grow from a twig or stem, but this is apparent only, and consequent upon its great development. Actually, it invariably originates in a leaf, or in leaves—the insect ovipositing in a leaf-bud. The number of cells in these galls varies greatly. Sometimes there are as few as three; while in the case of a very large specimen there may be as many as forty or fifty. The mass of



SECTION THROUGH A SMALL "BEDEGUAR" GALL OF
ROSE BUSH, SHOWING GRUBS IN THEIR CHAMBERS.
(Magnified.)

cells is entirely concealed under a dense growth of long, many-branched fibres, which possibly represent the abortive attempts of the irritated meristem tissue to develop into leaves. In colour, these fibres are green, pinkish or crimson, and the whole gall is a very pretty object.



"MARBLE GALLS," FORMED BY *CYNIPS KOLLARI*.

The next of these rose-bush galls is that formed by the fly called *Rhodites eglanteriæ*. It is about the size of a pea, greenish ripening to crimson as to colour, and must be looked for upon the under side of the leaves. Each of these galls has only one tenant, except in rare cases where marked distortion suggests that two or more galls have coalesced on account of their juxtaposition upon the leaf. The third gall is formed by *Rhodites nervosus*, and is also found upon the under side of the leaf. But it is perfectly distinct from the kind just mentioned on account of the thorn-like projections which spring from its surface, like the spikes on a mediæval war club. Almost any hedgerow in England will supply specimens of these three galls, so that the reader may readily compare them, and breed from them their respective tenants. In the case of each species the eggs are laid in the spring or early summer, while the galls reach perfection about September. In the autumn,

the two unicellular galls fall to the ground, whereas the big "bedeguar" remains on the bush throughout the winter. The grubs pupate within the galls, and the perfect flies emerge the following year, to perpetuate their species (and the respective gall formations) in a perfectly straightforward manner, and without the intervention of a perplexing agamic generation.

The Gall-fly which, in many respects, is at once the most curious and the most interesting of all the species found in England, is the insect which comes from the well-known "Marble Gall," often produced in such numbers upon young oaks, or upon the shoots of pollarded oaks in hedgerows. *Cynips*



kollari is the name bestowed by science upon this Gall-fly, in compliment to the old Continental naturalist, V. Kollar, who first noticed it. Curiously enough, this insect—which had been well known in Europe for very many years—was not observed in England until the year 1834 or thereabout. By some means the fly, or its galls, must have been introduced to this country, and so well did the change suit it that, twenty years later, the species was reported as being abundant in the south-western counties, where it had gained the popular name of "Devon gall." To-day, it may be found in most parts of England and

GALLS OF *RHODITES NERVOSUS* ON WILD ROSE LEAF.

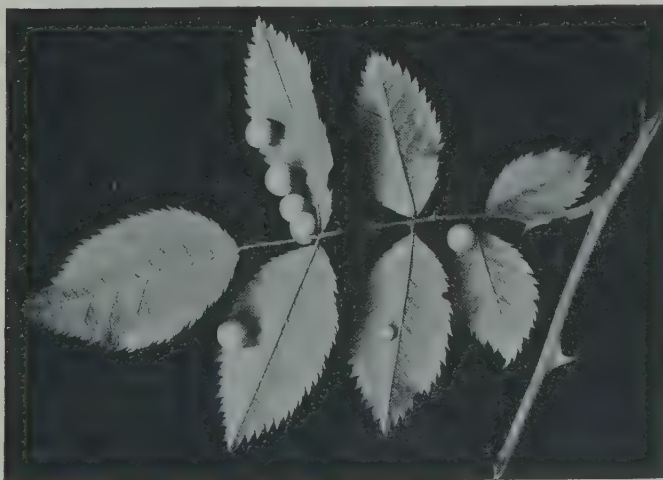
in many parts of Scotland; and its best-known popular title is the "Marble Gall"—a name which aptly describes its appearance.

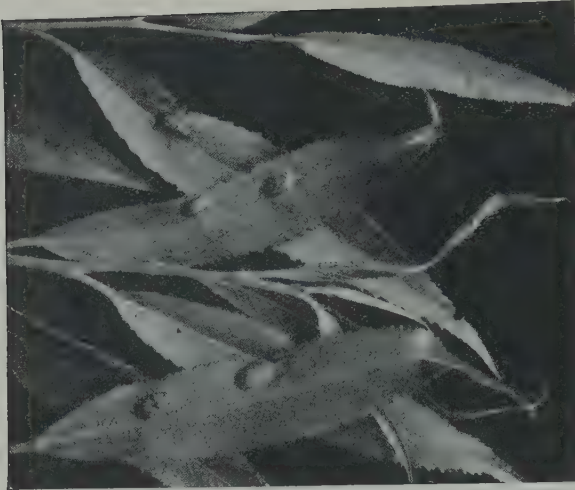
The Marble Gall-fly is slightly less than one-sixth of an inch in length—that is, from the front of its head to the end of its body. As Gall-flies go, it is a large species. After many fruitless attempts, I succeeded in obtaining a magnified photograph from life of this insect. It is seen resting upon the summit of its gall, close to the hole which it has bored in order to escape. The photograph gives a good idea of the strange "humpy" form of the tiny insect; while the relatively ample wings (they are about 11 millimetres, or not much under half an inch, from tip to tip when extended) are well indicated.

I have already said that the Marble Gall-fly is, perhaps, the most curious of its kind. This estimate is based largely upon the well-nigh incredible fact that every specimen which has ever been seen by naturalists

has proved to be a female. Enthusiasts in the past have collected many hundreds of the galls, and examined carefully each insect that emerged from them. But the result of these researches has always been the same. Not a single male has been found. Indeed, it is scarcely too much to affirm that no male of the species exists; that it has become totally extinct.

Now, as this Gall-fly is known to complete only one generation in the year, it is at least conceivable that the species may, in times past, have been "double brooded," producing a sexual generation in alternation with the agamic one. Still allowing our imagination to wander, we may suppose that for some reason quite outside our knowledge, the sexual generation became obsolete, leaving the "lone ladies" of the agamic brood to perpetuate the species. Such a supposition would serve to explain in some measure the amazing state of things which at present obtains. But I must warn the reader that we are now wandering quite outside the region of ascertained fact. All that we really know is that this strange Gall-fly continues year after year, one generation succeeding another, and yet no male individual is known to exist.

GALLS OF *RHODITES EGLANTERIÆ* ON WILD ROSE LEAF.



"HORSE BEAN" GALLS ON LEAVES OF "CRACK" WILLOW,
CAUSED BY A SAW-FLY, *NEMATUS GALLICOLA*.

So far I have spoken only of the typical Gall-flies which constitute the scientific family *Cynipidæ*. But galls are also formed by many other kinds of insects, often by species closely related to others which lack the gall-making instinct. Take, for example, the familiar bean-shaped swellings, perhaps one-quarter of an inch in length, and bright scarlet as to colour, which are found so abundantly on the leaves of the "crack" willow. These are the galls of *Nematus gallicola*—a Saw-fly belonging to the same genus as the well-known Gooseberry Saw-fly, which often does much damage in gardens by eating the leaves of gooseberry and currant bushes. This Willow Saw-fly is double brooded; but, unlike the Gall-flies of the family *Cynipidæ*, the individuals of both generations resemble one another, and the galls are identical. Briefly, the life story is as follows: The parent insect of the first generation lays her eggs, by means of a wonderful twin saw ovipositor, within the leaf buds during April and May; and as the leaves unroll, the scarlet gall structures develop. For several weeks each gall is a solid mass of vegetable tissue with the egg lying in a small cavity near the centre. Then the larva hatches and feeds upon the inner portion of the gall, from which, when full fed, it issues and drops to the ground. Here it forms a tiny cocoon of earth grains, becomes a pupa, and ultimately

appears as a perfect fly. This happens in August or September, and each newly emerged female Saw-fly oviposits in developing leaf buds, with the result that a second edition of scarlet bean-shaped galls shortly appears; a second generation of grubs falls to the ground to pupate before the approach of winter; and a second generation of Saw-flies appears in the following spring to perpetuate the species during another year.

Many of the true flies (with two wings), the *Diptera* of science, are bred in galls; so also are some of the *Aphides*, or "Green-fly." The caterpillars of at least two moths form galls, one species in the twigs of the white poplar, the other in the twigs of the Scotch pine. Among beetles, the family of the Weevils includes several gall-makers, one of them—the Turnip Gall Weevil—taking rank as an insect injurious to agriculture on account of the damage which it does to root crops. But possibly the best known gall-forming beetle is that pretty little member of the *Longicornia*, called *Saperda populnea*, the larva of which passes some eighteen months within a gall formed in a twig of the aspen poplar—the whole transformation of the beetle occupying two years.



ONE OF THE FEW GALLS
FORMED BY A BEETLE.
Section showing interior (with
grubs and pupa) of galls of
Poplar Long-horn Beetle.



FISHING FOR STICKLEBACK.

POND LIFE—IV

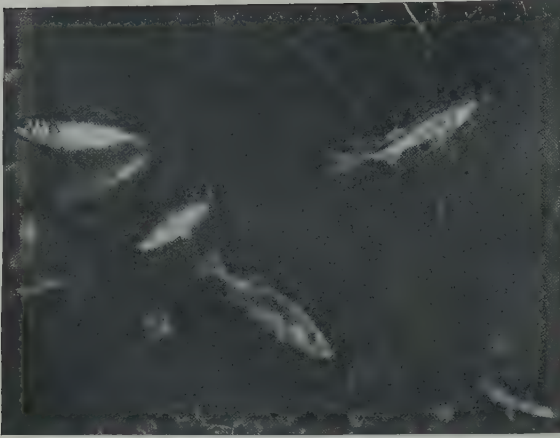
By F. MARTIN DUNCAN, F.R.P.S.

With Photographs by the Author

WE now come to the consideration of the larger inhabitants of the pond. One of the most interesting, perhaps, is the Stickleback; that graceful and active little fish beloved of our youthful days. The Stickleback is in many respects a very remarkable fish, and is possessed of considerable personality; in the spring of the year the males become very active, pugnacious, and handsome, their colours being very bright during the breeding season. As the season advances the male fish will swim about amongst the weeds, closely examining each clump, and poke his nose amongst the stones and shingle seeking for a suitable place in which to

build his nest; for the Stickleback indulges in the bird-like habit of building a nest for the reception of its eggs or spawn.

The nest is a really remarkable structure. The male Stickleback first makes a small depression in the sand or shingle at the bottom of the pond, and in this places tiny pieces of weed and fibre to make a soft resting-place for the eggs, and over all he spreads a silken coverlet, formed from a natural secretion that the male Stickleback possesses, mingled with particles of fine dust or sand. When the nest is completed, the little Stickleback, in all the glory of his courtship colouring, goes forth to seek his lady-



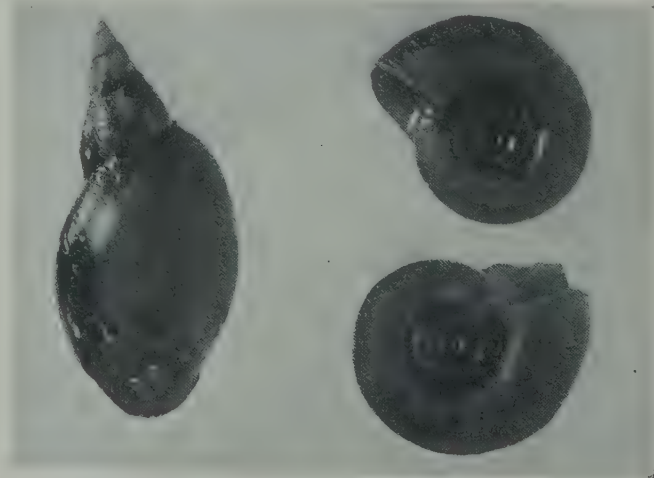
STICKLEBACK.

love, and lead her to the nest. He soon finds out, however, that the old adage that you may lead a horse to the water but cannot make him drink unless he is so disposed, applies equally well to his mate, who, although quite willing to observe the nest he has built, shows at first considerable reluctance to enter it; and it requires all the perseverance and powers of persuasion of the excited little male fish to induce her to enter and deposit her spawn. At last, however, the female Stickleback goes into the nest, but directly she has placed her spawn therein, she emerges and departs, leaving to her little mate all the anxious and responsible duties of looking after the eggs until the young emerge and can fend for themselves. The father Stickleback takes up the burden of his duties quite cheerfully, and tends his precious charge with the greatest devotion, never straying far from the nest until the young are hatched. All day long he mounts guard, attacking and driving away any unwelcome visitors who attempt to approach, and keeping up a constant and vigorous fanning with his fins at the entrance to the nest, thus causing

a continuous current of fresh, well oxygenated water to pass through it.

The Stickleback is not very difficult to keep, and forms a most interesting addition to the fresh-water aquarium, where we have an opportunity of watching its habits at our leisure; and I shall always have a vivid recollection of a particularly bright and pugnacious Stickleback who one spring built his nest in one of my aquaria. He was a handsome, lively little fish, doing combat on all and every occasion with his rivals for the fin and heart of his lady-love.

In due course the nest was built, the lady Stickleback, after much fussing, had been induced to enter and deposit her eggs; then after the manner of her kind, she departed to enjoy herself, leaving her mate to his arduous duties. These he fulfilled to the very letter, never quitting his guard over the nest for an instant except to chase away some real or fancied foe. Just before the period of the incubation of the eggs was completed, however, three or four vigorous and highly inquisitive Caddis-worms were unfortunately introduced into the tank. From the moment of their arrival the poor little Stickleback knew no peace, and was indeed almost driven crazy



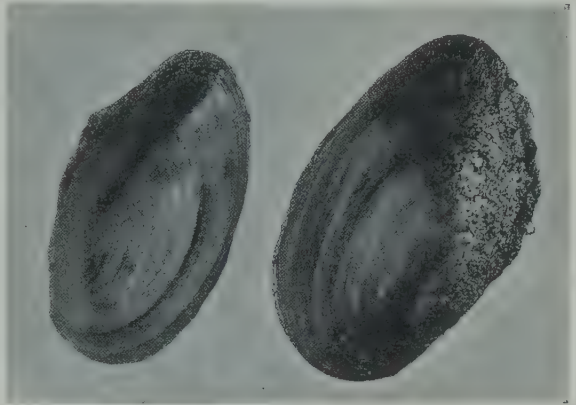
LIMNÆA STAGNALIS AND TWO SHELLS OF PLANORBIS.



LIMNÆA AURICULARIA.

by their untiring efforts to explore, or walk over his nest. A Caddis-worm would come crawling along, quite regardless of the rapid, warning movements of the little fish, and blunder right on to the top of the nest. The Stickleback would rush at the writhing Caddis, pull at, and more or less successfully disentangle the obviously protesting insect, haul it clear of the nest, and after administering a good shaking, carry the Caddis off and deposit it at the furthest corner of the tank. Not infrequently by the time the indignant parent returned, he found another Caddis so hopelessly mixed up in the silken threads of the nest, that he had to content himself with making sudden angry little rushes and tugs at the entangled insect until it managed to climb out. It is certain that during the next two or three days every one of those Caddis-worms fell into the nest three or four

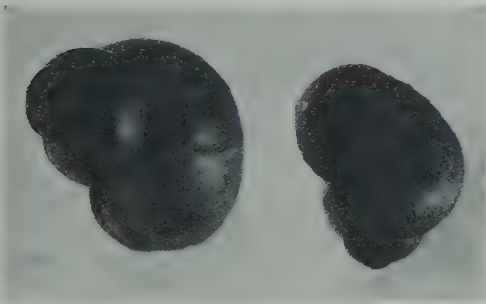
times, and was hauled out, and across the tank, by the infuriated Stickleback, but they did not seem to gather wisdom by their experience, but blissfully continued to crawl back again to the nest as if they were so many needles attracted by a powerful magnet. At last the tragic end came. In the course of an extra vigorous tussle the nest was torn to pieces, and the eggs dispersed. In an instant the other Sticklebacks, who up to that time had from a distance been passive spectators of the struggle, joined in the fray, and for a few moments a scene of unseemly confusion took place, as they swam rapidly backwards and forwards over the ruins of the nest, greedily devouring the exposed and unprotected eggs. In vain the frantic little father



THE GREAT SWAN-MUSSEL (*ANODONTA CYGNEA*).

Stickleback tried to drive them off; the commotion only served further to disintegrate the nest and scatter the eggs, and in a very few minutes this little aquatic tragedy was ended.

The Newts, or Efts, are true pond-dwellers, and it is an interesting sight in late spring to watch the females depositing their eggs, one at a time, on the leaves of the water plants. The Newt, after depositing each egg, carefully folds the leaf over, so as to shield the precious egg from observation. Later on the little Newt-tadpoles make their appearance, and are well worth collecting and transferring to the aquarium, for they present a curious appearance, with their plume-like external branchiæ, or gill tufts.



SHELLS OF *PALUDINA*.

The tadpoles of the common Frog are also to be found in the ponds, and their gradual development is a most interesting and remarkable sight.

Every pond will be found to include amongst its inhabitants a number of shell-dwellers, the different species of Water Snails and Fresh-water Mussels. Though when collecting pond life one is apt to pass these creatures unheeded, they should not be neglected, for a little closer examination will show them to be very remarkable and interesting, and many of them display considerable beauty of colour and form.

Of all the pond snails, probably the one most frequently to be met with is *Limnæa stagnalis*. The shell of this snail is thin, horny, and ovately turreted, with an elongated and sharply pointed spire. It is a handsome creature, and fairly active. It crawls about amongst the submerged weeds, and when undisturbed, with its body fully protruded from its shell, will be seen to have a broad, short head, and somewhat flattened tentacles, near the inner base of which the eyes are placed. This snail may frequently be seen gliding along beneath the surface of the water, shell downwards, and if alarmed it will at once sink to the bottom of the pond. The *Limnæa* deposits its spawn in oblong, transparent masses on water plants and stones. With the approach of severe cold it becomes lethargic and hibernates in the mud at the bottom of the pond.

Limnæa auricularia, although not so common as *Limnæa stagnalis*, is by no means rare; while it has a much smaller shell, the body-whorl is larger than that of *stagnalis*, and has the outer lip reflected.

The most abundant of our native species of *Limnæidæ* is the *Limnæa peregrina*. It is a most extraordinarily prolific creature: Dr. Gwyn Jeffreys states that it lays about thirteen hundred eggs in numerous clusters. It is very active in its movements, and is given to creeping up the stems of the aquatic plants and remaining for some time out of the water.

Planorbis is another water snail commonly found in ponds. It is a creature with a very wide distribution, species being found throughout Europe, North America, India, and China. In all there

are some 145 species in existence, while about sixty-nine fossil species have been found in the Wealden formation, in company with some seventy species of the *Limnæidæ*, which shows that these pond snails are a very ancient race of creatures. *Planorbis* has a characteristic habit when crawling along, of trailing its shell behind its half-extended body.

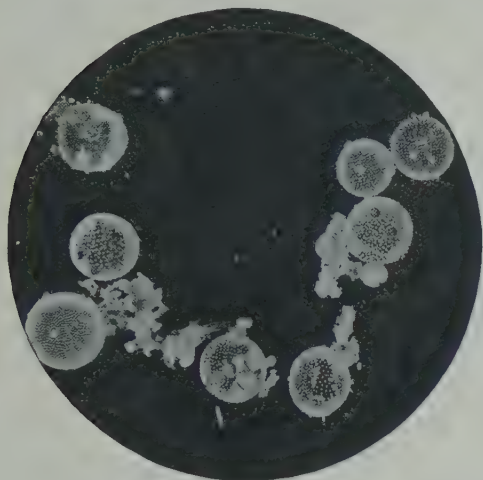
Paludina vivipara also comes of an ancient stock, the fossil remains of its ancestors contributing largely to the composition of the marbles of the Wealden and Purbeck beds. It is a pretty active snail, and has a rather handsome shell, ornamented with coloured bands. A near relation of *Paludina*, called *Bythinia*, is much smaller, and appears to be of a more social disposition, as it may generally be found in considerable numbers. While *Paludina* is viviparous, that is to say, generally brings forth its young alive, *Bythinia* is oviparous, laying from thirty to seventy eggs in a band of three rows on stones or pond plants. The young hatch in about three to four weeks, and take two years to attain their full growth.

The River Mussel (*Unio Margariferus*), to be found in ponds fed by streams, is particularly interesting from the fact that it is the species that provided the once famous British pearls. The Scotch pearl fishing was at one time an industry that yielded a profitable harvest, and the pearls were usually found in old and somewhat deformed specimens of mussels; round and perfect pearls about the size of a pea were worth from £3 to £4.

Sir R. Redding, in the "Philosophical Transactions, 1693," gave an account of the Irish pearl-fishing, in which he states that the mussels were found set up in the sands of the river beds with their open side turned from the torrent, that about one in a hundred might contain a pearl, and that about one pearl in a hundred might be tolerably clear. It is not very surprising that with such a poor yield the industry has become practically extinct in both countries.

Anodonta, the Swan-mussel, is the largest of our pond and river mollusca, and is a very handsome and interesting creature. When undisturbed it may be seen with

partially opened shells, giving a view of its fringed syphons. It is a very prolific creature, the outer gills of a female having been computed to contain some



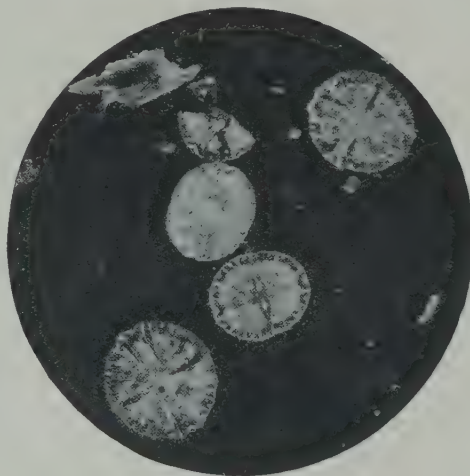
THE BEAUTIFUL AND INTERESTING *VOLVOX GLOBATOR*.

300,000 young shells. Like most of the pond mollusca, the Swan-mussel can boast of ancient lineage, for eight fossil species are to be found in the Eocene formation. Indeed, quite apart from their beautifully formed shells, and varied habits, the pond snails and mussels are an interesting group of animals on account of their forming such a remarkable and striking link with the past geological fauna of our country.

No description of pond life would be complete without a brief reference to some of the interesting and remarkable forms of plant life to be found in that environment. Of the Bladderwort I have already given a description in dealing with the life and habits of the Water Fleas (p. 721). First in interest, on account of its remarkable power of locomotion, is the *Volvox Globator*, which belongs to that debatable group of more or less simple organisms that partake of the characteristics of both plant and animal life. When seen under a moderate magnification the *Volvox* presents the appearance of a tiny hollow sphere, the outer walls of which look as if formed of a green lattice-work of cells. Careful and critical inspection will also reveal the

fact that each cell bears externally a pair of exceedingly delicate hairs or cilia, by means of which the *Volvox* moves through the water, and that certain cells are of a complex character, in which the young are formed. The *Volvox*, by means of its cilia, moves through the water with a rolling motion, and at a fairly rapid rate, and is a most beautiful and interesting object to watch by the aid of a low-power object glass under the microscope, when not only its movements can be closely followed, but the growth of the young, and their rolling movements within the parent sphere until its rupture sets them free, may be witnessed.

Next in interest to the *Volvox* are the Diatoms, those wonderful unicellular plants which secrete an indestructible skeleton of silica, the exquisitely delicate markings of which are the delight of all microscopists. Most of the pond Diatoms have the power of movement, travelling through the water at varying speeds. Exactly how the Diatoms propel themselves through the water is still a debatable subject. They abound in every pond,



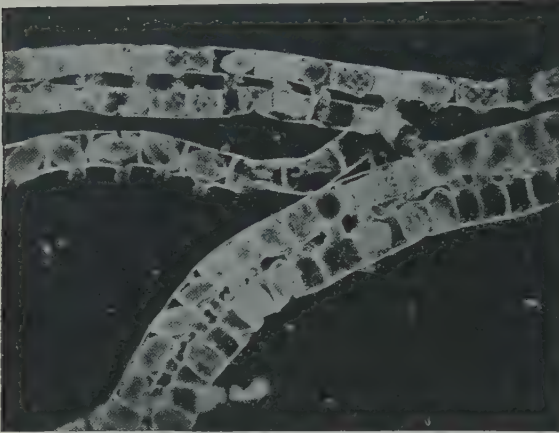
MICRASTERIAS ROTATA.

One of the most beautiful Desmids to be found in ponds.

frequently forming an olive green coating to the stems of the water-weeds, and sometimes quite a thick scum over the surface of the pond.

The Desmids are near relations of the Diatoms, but though they are capable

of independent movement, they do not form silicious skeletons, and they are peculiar to fresh water, while Diatoms abound in both fresh and salt water. Desmids vary considerably in shape and size, and are nearly all very beautiful and graceful of form, one quite common species resembling a tiny green new



FILAMENTS OF SPIROGYRA IN PROCESS OF CONJUGATION.

moon. A very handsome Desmid frequently to be met with in ponds and sluggish streams, is rather like a rosette in shape.

A very remarkable and interesting plant which should be collected from the pond in the spring of the year is the *Spirogyra*. It appears on the surface of the pond as small collections of very fine, almost hair-like stems, more or less tangled together. Under suitable conditions, it is possible to witness the whole process of reproduction in this plant, which is effected by a process called conjugation, and is very interesting. If some of the tangle of *Spirogyra* be placed in a shallow glass pan of water, the stems, if about to conjugate, will, with the aid of a magnifying glass, be seen gradually to straighten out and draw towards one another. As the stems draw

together, the cell walls down the side nearest to the approaching stem will in each case begin to swell outwards until at last they meet and join, giving the two stems the appearance of a miniature ladder. While the cell walls have been growing, the contents of each cell have been passing through a series of changes, until the whole protoplasmic contents has gathered towards the nucleus. When the two opposite cell walls have grown out and united, the nuclei of the two cells either both meet and join in the passage formed by the union of the two cell walls, or one of the nuclei passes through the passage into the opposite cell, where it comes into contact and fuses with the nucleus of that cell. As a result of the fusion of the two nuclei, growth takes place around them, and an oval resting spore is formed, the chains or ladders break up, and the spores sink to the bottom of the pond, where, after a certain period of rest, they start into active growth, each spore becoming the originator of one of the slender *Spirogyra* stems.

In the foregoing articles I have endeavoured to give some account of a few of the wonders and curiosities of pond life, but it would require more than a dozen volumes of *THE NATURE BOOK* to do anything like justice to the teeming animal and vegetable life of the pond. Every pond will be found to have its own characteristic forms of life, for variation of locality, vegetation, and water supply, are determining factors as regards the number and species of creatures and plants to be found in each pond. While some forms of life are present in every pond, others are extraordinarily local, but during most months of the year the lover of Nature will find some object of interest in the wayside pool, some beautiful or curious representative of pond life.

F. MARTIN DUNCAN.





A HERBACEOUS BORDER IN GREENWICH PARK.

NATURE "IN TOWN" GREENWICH PARK

By ARTHUR SCAMMELL

Illustrated with Photographs by W. J. VASEY

THE tide of modern industrialism has long ago flowed over the district of Greenwich, sweeping away much, and disfiguring all; but there are parts of the town where yet the steep and crooked streets, the old Kentish houses set in older gardens, and the dominance of venerable high-set trees, keep for the place something of its ancient and royal distinction.

And that which is true of the town is still more characteristic of Greenwich Park. The steep escarpment, with the great ship-laden river at its feet, the prevalence of large and ancient timber,

the stately avenues, the deer, the landscape gardening of the Stuarts, and the architecture of Wren, combine to remind us at least of its former condition as a noble and stately domain, a home for kings rather than the resort of a populace.

It is impossible to separate from the enjoyment felt in this beautiful scene a strong sense of the numerous associations which attach to it. Romans, Danes, Saxons, have left vestiges of their works here, and their ashes still lie beneath the turf. Where is now the Naval Hospital stood the Royal Palace of Placentia, much favoured of Tudor and Stuart

kings. There is the oak, dead now, but green with ivy, under which Henry VIII. is supposed to have danced with Anne Boleyn; and in the hollow of which Queen Elizabeth is said to have supped. Down at the landing-stage Raleigh bridged the pool of Thames mud with his cloak. "Masques and Musique," feasts and revels for kings and courts, Greenwich Fair for the people, and Greenwich Observatory—with its chronological authority, greater, one may say, than that of the sun himself—for the whole world.

After all, however, the chief glory of a park is its trees; and of all the trees, indigenous or introduced to this country, the tree of Greenwich Park, the Spanish Chestnut, is that best calculated to produce, in garden or landscape, the effect of dignity; distinguished by comparative rarity, of slow but not sluggish growth, of lofty and symmetrical stature, with limbs well proportioned to its girth of trunk, with its deeply corrugated bark, set in noble spiral ridges that suggest so much of strength and antiquity; and shapely saw-edged leaf of pure dark

green, and firm, yet sensitive texture; the tree well recalls the best associations of its name, the Spaniards' strength and the Spaniards' sombre pride.

The legend which connects the name of Evelyn with the planting of these chestnuts appears to be founded merely on inference—a quite natural inference, however, since he praises the chestnut for "Magnificent and Royal Avenues," a term peculiarly applicable to Greenwich.

The direct reference which occurs in his diary is not to the chestnuts, but to the elms, which he says were planted by his Majesty Charles I. in the year 1644.

There can be little doubt that many of the Spanish chestnuts are of much greater antiquity than this. They probably belong to the period of the enclosure of the Park (by Humphrey Duke of Gloucester), *circa* 1430; whilst the great oak, "Queen Elizabeth's dining room," had no doubt flourished, a stately tree, upon Blackheath long years before that time.

Speaking of the fruit of the chestnuts, Evelyn says: "We give that food to our swine . . . doubtless we might propa-



THE DELL.

gate its use among our common people." The amiable diarist would no doubt be gratified to see how amply his prophetic hint has been acted upon by "the common people," especially the boys, that frequent the Park to-day. In the old time the beating of the trees was carried out as a necessary work, and at considerable cost; but we have changed all that—the beating is informal, done with sticks, stones, caps and other missiles, and entirely *con amore*; occasionally a keeper will catch one of the amateurs at work, and then the tree has its revenge!

With an interval or two, perceptible now in an unequal gradation of size, chestnut planting seems to have gone on fairly continuously, especially during later years; and naturally the better part of the fruit is borne by the young trees. The advantage of youth, however, goes no further.

Independently of size, and the increased dignity which goes with it, the old chestnut is a much handsomer tree than the young; the main difference lies in the bark—perhaps the chief glory of the full grown or ancient tree. One can only wonder at the magic which converts the lifeless, lustreless casing of the young chestnut, pale yet dingy, neither smooth nor rough; and makes of it this marvel of ridge and spiral, and intricacy of network, and engraves upon every inch of its surface these quaint and lovely devices, so that the tree stands complete, like a great art work, perfect in form and colour, in majesty of stature and beauty of detail.

But alas for strength! Alas for beauty! Mere grass for the scythe of Father Time! All the trees of the first planting are more or less decayed; some of them mere wrecks; but still the spring brings



A QUIET SPOT TO REST.

fresh green to them as to the youngest; still they hold up their broken and blackened limbs to feel again the blessings of sunshine and air, and to invite the birds to shelter and nesting as of old.

The elms of Greenwich Park, notwithstanding the advantages of royal planting and cultivation, are, on the whole, somewhat disappointing. Set much too closely together, the size even of the largest is only moderate; many of them lean considerably, a most unfortunate defect in an arcade. The capricious habit of the elm in the extension of its branches is here seen in excess, the branching of many of the trees being not only irregular but insufficient; whilst the hand of man, felt in the more or less necessary dismemberment of old trees, seems to have had a more than usually disfiguring effect.

As in the case of the chestnuts, perhaps the best elms are those out of the avenues, growing singly or in irregular groups, and the pasture lands (as distinguished from the pleasure grounds) of the Park form a simple rural setting proper for the tree; only the presence of browsing sheep and cattle is needed, or great cart horses freed from harness and labour, taking their ease in the grass.

Upon one of the grassy knolls, artificially steepened, and approached by a little winding grassy way, hollowed out probably by spade work of eighteen hundred years ago, are the scanty remains of a Roman villa. A few fragments of cut stone, tile-brick, rubble, and a little piece of tessellated pavement, are all that can be seen above ground. What may lie below, who can tell? But it is certain that here was once a human home, the scene of intense and varied human emotion; the pride of the patrician, the subjection and labour of the slave, with the familiar domestic affections common to both.

And the elm, that is ever found in

human neighbourhood, that clusters about the homesteads and shadows the graves of so many an English village, the elm is here, surmounting the grassy hillock, befriending with its pleasant life this forlorn haunt of the dead. Decay has long been doing its work upon the tree itself, stamping it with the seal of mortality, and making it a still more pathetic memorial of vanished life and things forgotten.

A part of the Park, on the Blackheath side, is reserved of necessity for the use of the deer; and for such a purpose no one can begrudge the sacrifice. But a sacrifice it is, and a costly one; for the "Wilderness," as the enclosure is called, is a very delightful and characteristic bit of woodland scenery.

Oaks, bracken and fallow deer! Surely in these we have the very essence of Old England's—Merrie England's—greenwood scenery, and we cannot look upon them to-day without seeing all the sunshine of old romance quivering about them. Their glades are for ever peopled with



ONE OF THE GRACEFUL CURVES.



A GLIMPSE OF THE POND.

Pucks and Robin Goodfellow and all their elfish company; with Robin Hood and his merry men; with all the nut brown maids of all the ballads; and with Rosalind and Celia, Orlando, Jaques, and many another of Shakespeare's woodlanders.

The visitor privileged to enter the Wilderness may see the trees, the bracken, and the deer to-day, with as much else as his fancy may suggest. He will also see, in their season, flowers that seldom bless the Londoner's sight—wood anemones, wild hyacinths in the abundance which is necessary for their proper effect, mulleins both the great and the white, with patches of Lenten lilies, either growing wild or as strays from the gardens, the blue eyes of the speedwell, and wild strawberry blossoms among the moss.

The highest expression of natural delight can never be found in any park, public or private. One must go to the wild for it. The brook that dances and sings its way down the mountain side, the rowan that tosses its hair to the mountain breeze, the mosses that cover the stones, and the daisies which spring amongst them; these, with the primal freedom of wide skies and unploughed earth, are Nature's best, and have a greater power to charm than all the pride of the Dukeries.

We have not, however, the mountains here, but only Greenwich Hill; no wild, only a garden. Well, let us see how our garden grows, and what, if anything, can be gathered from it of the quality which we desire.

Well back on the hill plateau, the gardens and groves which surround the Ranger's House form the happiest hunting ground for such a quest. The old house, with its long, mellow-tinted front, facing the sunrise, has an air of peaceful homeliness, and gives proper character to the smooth lawns and chastely ordered flower beds. A little orchard lies at hand—crooked trees knee-deep in grass, with daffodils in early spring, and later white with cow parsley; beyond, the moving forms of deer beneath the trees.

A cedar grows upon the lawn, and, with perhaps equal beauty and distinction, Scots firs, lifting their ruddy stems into the sunshine. Great banks of rhododendrons thrive in the gravel soil; sycamores with mottled bark, oaks as yet unspoiled by London smoke, some noble thorns, with undergrowth of evergreens, form covers for secluded alleys—dark shadowed, yet streaked with beams of sunshine.

Pacing these walks, strolling about the lawns, or sitting in the grateful warmth of the early sun, the silence only broken by the incessant stream of bird song, that which is artificial in the scene begins to count for less, and the natural for more; the notice boards, iron railings, seats and other necessary afflictions sink to something like their true insignificance, and the pure joy of the morning, the glory of the sky and the unconquerable beauty of trees, begin to work their proper effect upon the mind; the shadows become substances and the real shadowy; and by the time the postman and milkman come bustling through the Park, one may have well-nigh forgotten the everyday prosaic state of existence, wherein the fetching and carrying of messages, and the supply of mere bodily wants, are, perhaps justly, considered necessary matters. Necessary, of course; but how well and happily sometimes forgotten. This is the true leisure—the mind occupied indeed, but occupied with matters that, in a worldly sense, do not concern us. "He that observeth the wind shall not sow, and he that regardeth the clouds shall not reap." Well, we need not always be sowing and reaping and gathering into barns: better sometimes to be idle and to dream; to be enamoured of the grace of tall elm tops stooping and rising to the wind; to be entertained by the glitter of the brightly coloured beetle amongst the grass blades; to let the idle sight follow the idle flitting of the butterfly; and the ear listen to the faintest, furthest going of the cuckoo's note, and to watch for and to gather the first and sweetest wild rose of the summer.

ARTHUR SCAMMELL.



A STUDY IN SEA "FIRS"

By S. F. MAURICE DAUNCEY

Illustrated with Photographs by the Author

IF during a holiday at the seaside you have chanced to walk along the beach after a heavy sea, you will have wondered at the strength of the waves. Here a bank of pebbles where the children were playing yesterday has been swept away; further on the rock against which you used to lie is no longer visible, and in its place is a mass of shingle and weed.

During your ramble the high-water line may have attracted your attention.

At first sight what is gathered there has looked like a bank of rubbish, but upon closer observation it has disclosed hidden treasures. What an assortment of goods it has to show if you only take the trouble to turn over its tangled mass with your stick!

Blocks of wood covered with barnacles tell of the destruction of some old wooden groin. Here a crab, unable to regain the water, there a star-fish stranded in the confused weed, a few steps forward the shell of a sea-urchin—these objects tell of the force of the waves which has brought them so far up on the shore.

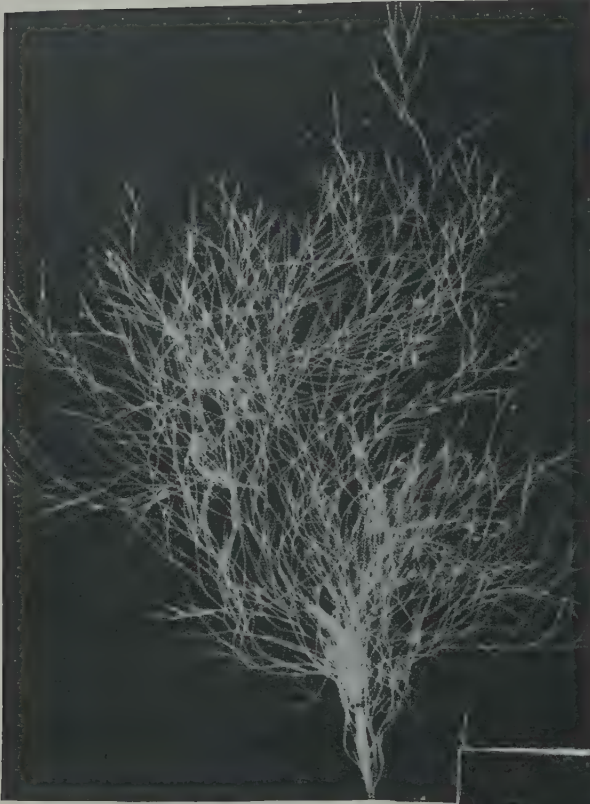
If you have stayed to examine some of the pieces of seaweed or bits of rock, you may have noticed a fine lace-like structure attached to them, or it may be washed free and lying on the beach. If, further, you have examined this structure with a pocket lens, what a surprise you have had.

It is composed of tiny cells

and they form a horny skeleton. You will at once know that it is not, as you first thought, a bit of fine seaweed; for seaweed is never made up of cells like these. What is it, then? It is the skeleton of a colony of zooids, and its common name is "Sea Fir"—a name given to it because of the fir-like appearance of some of the coarser varieties. When alive, each little cell contained a jelly-like form called a zooid, which helped to feed the whole colony by



"SQUIRREL'S TAIL."



"SEA HAIR."

catching microscopic atoms of food with its fine tentacles. The colony grows and grows, until there may be many thousands of cells all forming but one framework.

These colonies may, as suggested above, be found adhering to many different objects—*e.g.* shells, seaweed, and rocks: but the shell of a Spider crab is the finest building site, for the constant movement of the crab takes the colony into fresh areas in which to "fish" for food.

Of the three illustrations, No. 1 (*Sertularia argentea*) is commonly called "Squirrel's Tail," and the illustration shows how justified is the name. This "fir" is of a much finer form than some others, the cells being much smaller. No. 2 (*Sertularia operculata*), commonly called "Sea Hair," is extremely delicate, and has no central rib as the two other kinds have.

No. 3 (*Sertularia abietina*) shows that variety which has appropriated to itself "Sea Fir" as its common name. It is one of those most commonly found on the beach, and also one in which the fir-like growth is very distinctly seen. It is quite a stiff structure, and of a light fawn colour.

The photos here reproduced were obtained by the specimen being placed on a piece of plain glass in a printing frame, and a sheet of photographic paper being placed over it. The frame was then exposed in full sunshine until the part of the paper where there was no "fir" became almost black. The prints were finished by first washing for five minutes in a solution of common salt (1 oz. of salt to 10 oz. of water), then rinsing in clear water and fixing in hypo bath (hypo 1 oz., water 7 oz.) for ten minutes.



"SEA FIR."

THE "LIZARD" ORCHIS

A fine specimen of one of Britain's rarest flowers

By the REV. H. PUREFOY FITZGERALD, F.L.S.

THE "Lizard" Orchis (*Orchis hircina*) is one of the rarest of our British flowers: as far as I am aware, it has been found in only four of the English counties, so that it cannot be called a wayside flower, and happy is the botanist that has the good fortune to light upon a growing specimen. I do not intend to give any hints as to where it may be looked for, because in these days, when so many of our rarer plants are rapidly becoming extinct, owing to cultivation, building, and the greediness of many collectors, it is just as well to keep some things secret, as far as it is possible to do so.

The photograph depicts well the general shape both of the flower spike and of the individual blossoms. The latter are rather large, the sepals and side petals meet, forming a sort of hood; these are of a pale greenish olive colour, with purple spots. The most remarkable point about the flower is the shape and length of the lip or labellum, as it is called, of one of the petals. This is divided into three segments; two short pointed ones, one on either side, and the middle one

very long, generally over an inch. In the bud stage, this long lip is coiled spirally—on the flower opening the spiral uncoils to a large extent and becomes undulating; the end has the appearance of having been bitten off, leaving two or three small teeth. The colour of this long lip is greenish white, with a few purple spots at the base, and pale greenish olive towards the free end. The whole spike of loose flowers varies in length from four to eight inches, the plant being from one to two feet in height, it being one of the

tallest of our native orchids. The flower emits a somewhat disagreeable scent, which is said to resemble the smell of goats very strongly. This is the explanation of the plant's specific name, *hircina* (*hircus*, a goat). The descriptive name of the "Lizard Orchis" was given to it from the somewhat fanciful likeness of this flower, with its long, greenish lip, to this reptile. It is of no use hunting for this plant except in a chalky district. Woods and meadows in such a locality may chance to produce a few specimens; about the end of June and during July is the flowering period.



Photograph by Douglas English.

THE "LIZARD" ORCHIS.

THE LIFE STORY OF THE PAINTED LADY BUTTERFLY

By JOHN J. WARD, F.E.S.

Author of "Life Histories of Familiar Plants," "Some Nature Biographies," etc.
Illustrated from Original Photographs by the Author

RARELY can a butterfly be said to be cosmopolitan, but the Painted Lady almost achieves that distinction, for it is found (and often abundantly) in almost every country in the world excepting, perhaps, the Arctic regions and South America.

Although the insect frequently occurs in large numbers, yet the irregularity of its appearance is striking. Sometimes, for several consecutive years, the butterfly collector diligently searches in vain for specimens; then some day unexpectedly, as he saunters along, he is overjoyed at the sight of one of these handsome insects on the wing. With net in hand he wildly pursues it, and the butterfly eventually alights in a meadow near by where thistle or clover blooms abound. Imagine, though, the astonishment

of the collector when, after carefully approaching the spot, he finds resting on nearly every flower a Painted Lady Butterfly—a multitude of them before his eyes. Such an incident has happened to

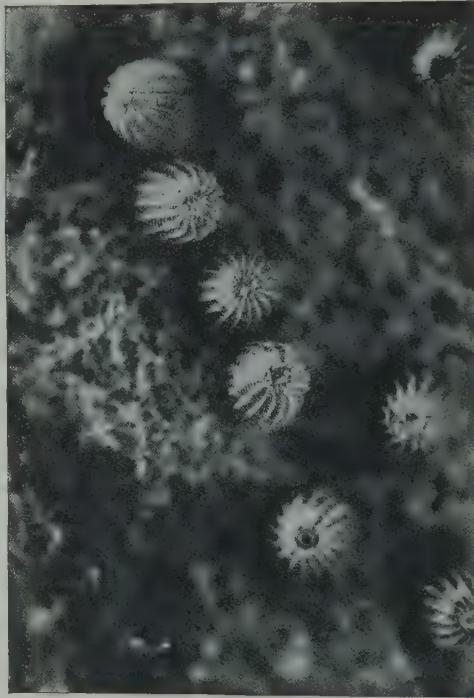
various entomologists in nearly every corner of the earth. Where the insects come from so suddenly after, perhaps, years of absence, has long been a puzzle. However, the fact that these insects migrate is now fairly well established; and

this habit of migration, leading small or large groups to take advantage of suitable winds for the journey, probably accounts for the cosmopolitan distribution of the species, and at the same time for its numerical strength, for the race must naturally benefit by dispersal of its superfluous numbers to fields and pastures new.

Having now accounted for the sudden and extraordinary appearance of the butterfly, we may proceed to consider the details in the life history of an individual.

It was in the early morning of

the 8th of June—the year need not concern us—when one of these butterflies suddenly put in an appearance on the English coast at Folkestone and selected its pitch of land—for an attachment to a

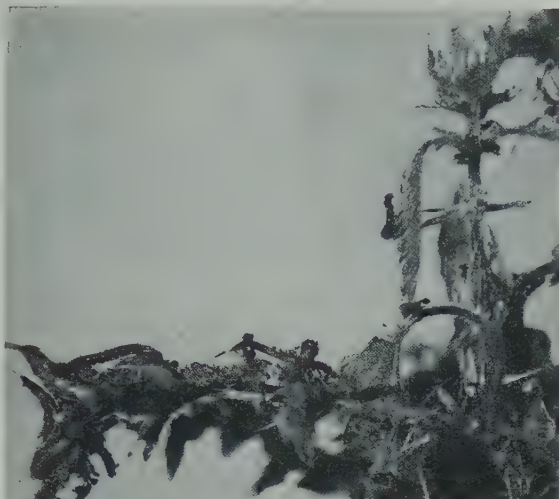


A MAGNIFIED VIEW OF SOME OF THE BUTTERFLY'S EGGS.

particular area, or stretch of land, about which they often career for several days together, is another curious characteristic of this species of butterfly. So our butterfly kept up the traditions of its race, and boldly manœuvred to and fro over its plot, occasionally resting and sunning itself on the tops of some tall thistles, where the charming chestnut browns and reds of its wings, contrasted with the black and white of the fore-parts, gave it a most fascinating appearance.

After it had worked off some of its superabundant energy, and had sampled the various kinds of nectar from most of the flowers that grew in its domains, this Painted Lady (for such she was in the strict sense of the word) proceeded to business. She made a kind of slow circular tour amongst a clump of thistles and nettles which were growing together, fluttering from plant to plant, and moving amongst their leaves as if carrying out a botanical investigation. A careful examination of a leaf on which the butterfly had been at work revealed some tiny pale green bodies dotted over the leaf—so small that four or five could comfortably rest on the head of a pin. Nevertheless they were wonderfully interesting little objects—the butterfly's eggs, indeed; and on page 778 some are shown as seen through the pocket lens of the writer.

Seeing that the butterfly herself feeds on the sweet nectar of the flowers, it is



FROM THE EGGS
CAME LITTLE
CATERPILLARS
THAT SOON
MADE INROADS
INTO THE SOFT
PARTS OF THE
LEAVES.



WHEN THREE WEEKS OLD THEY SWARMED ABOUT
THE NETTLES, AND ALL SEEMED DESIROUS OF
FEEDING UPON THE SAME SPOT.

quite marvellous how she knows that her offspring will need green thistle and nettle leaves to feed upon; yet with unerring instinct she places her eggs amongst the

leaves, and, apparently, she does not consider it important whether they are those of the thistles or the nettles.

Five days later (June 13th) the butterfly had disappeared. Indeed, it was

highly probable that the spark of life within its frail structure had by that time succumbed to the large demands made upon it, for it is seldom that the insect lives for many hours after depositing its numerous eggs. However, the safety of her species was ensured. The tiny and prettily decorated eggs, which she had placed so carefully and systematically amongst the leaves, were now bursting open, and from each broken shell emerged a little caterpillar—a baby Painted Lady!



WHEN FOUR WEEKS OLD THEY WERE
FULL GROWN.

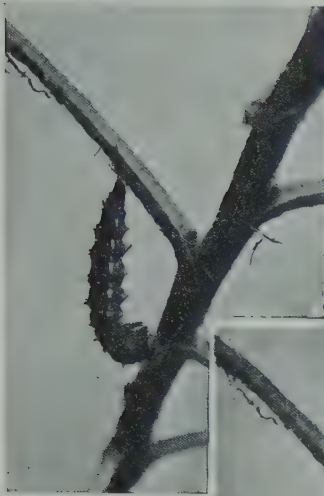
These insect infants were greyish in colour, with rather large, shiny black heads, and covered with short bristles, and, of course, were very tiny when they first appeared. They soon proceeded to business, and made inroads into the soft parts of the leaves, and, at the end of a fortnight, their bodies darkened in colour, and they became conspicuous about the food plants (see p. 779). A week later still, they were exceedingly busy, and swarmed about the nettles; and the following week (July 10th) the caterpillars were full grown. They were then anything but handsome, their only decoration being some yellowish markings about their

bodies; but not the slightest indication was visible that they were presently to become lovely butterflies.

Eventually, one of the larvæ stopped feeding, and, after carefully selecting a suitable site beneath a leaf-stalk, it slowly proceeded to spin a silken pad or cushion to it, finally attaching itself to this cushion by its tail claspers. In this way it suspended itself upside down, and there it hung a most dejected-looking object (p. 781). After it had been so hanging for a few hours, it commenced to squirm and wriggle its body, when its skin near the back of its head suddenly burst open. Then the caterpillar moulted its skin, for as the body wriggled the skin slowly shrunk up towards its tail-end, where it was attached to the silken cushion. The second illustration on page 781 shows this process taking place, just at the half-way stage. At the end of four minutes the shrunken skin was free, but it could not yet fall away, for it still had to be freed at the point of attachment to the stem. Presently, though, the developing insect detached itself, let the skin drop to the ground, and then re-attached itself to the silken pad (p. 781). This seems a very extraordinary feat, for, apparently, the insect must loosen its hold while allowing its cast skin to fall. However, close examination shows that at the extremity of the body are numerous minute hooks by means of which the insect attaches itself to the silken pad. It therefore probably detaches some of the hooks while the others remain connected, and so the skin is gradually passed over the point of attachment and falls to the ground. We no longer, then, have a caterpillar to consider, but a pupa, or chrysalis—the next stage of the insect's development.

The chrysalis is at first of a greyish colour, but when it has been hanging for a few hours its angles become burnished, and it then presents metallic shades of various hues—green, crimson, gold, and silver, according to the position from which it is viewed.

On July 11th two larvæ became chrysalides at almost the same time beneath the cleaned central vein of a thistle leaf on which they had been feeding (p. 782), and there these pupæ hung motionless.



THE FULL-GROWN LARVA SUSPENDED ITSELF BY ITS TAIL-END, AND PROCEEDED TO—

for twelve days (July 23rd). But not until the end of that time did it become obvious that some further development was taking place. The chrysalides then lost their metallic splendour and became greasy, and through the outer skin the coloured wings of the butterflies, now almost ready to appear, became visible.

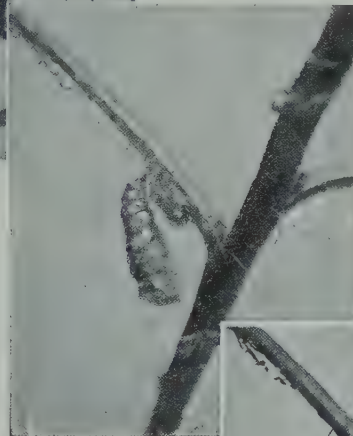
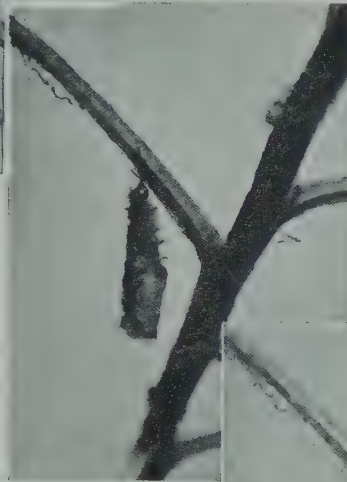
So few persons have seen a butterfly emerge from its chrysalis into its world of sunlight, that here was an opportunity not to be missed. To seize the opportunity, however, was not so simple as it seemed. Although we know from external happenings that the butterfly is almost ready to appear, yet just when it will emerge we are quite unable to foretell. Therefore, we have to wait Nature's time. This waiting sometimes becomes tiresome, for the butterfly may appear at any moment during about twenty-four hours from the time the chrysalis changes its colour;

occasionally the butterfly emerges almost at once, while others may wait the whole of the twenty-four hours, or even longer; so that there is no criterion as to the exact time when the insect will appear. It is, therefore, essential that a careful and persistent watch should be kept upon the chrysalis, especially as the butterfly only occupies a few seconds in making its emergence and fully extending its wings.

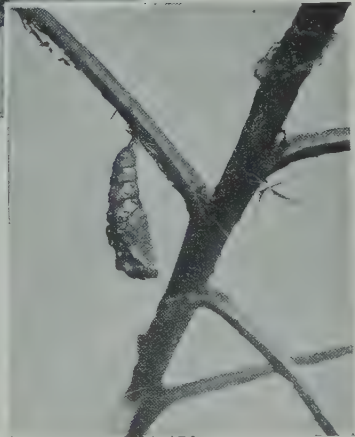
After six hours of waiting, one of the chrysalides under observation suddenly moved—just a slight jerk. Then the broad end gently bulged and burst open. Through the opening immediately appeared the head of the butterfly, quickly followed by the fore-legs, by means of which the insect gripped the stem and so assisted in more comfortably extricating its latter parts (p. 783, No. 1). A moment later it was on the stem, leaving behind it the broken and empty chrysalis skin; and in this way the chrysalis changed to a butterfly.

How disappointing, though, is our butterfly! It has dumpy wings, looks like a cripple, and is altogether unlike the parent

MOULT ITS SKIN. ABOVE IT IS SHOWN AT THE HALF-WAY STAGE.

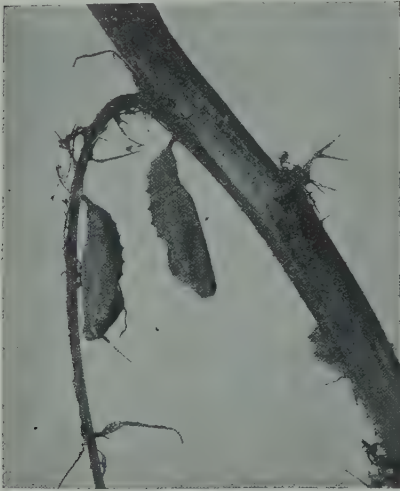


AT THE END OF FOUR MINUTES THE SKIN WAS FREE AND THE CATERPILLAR HAD BECOME A CHRYSALIS.



FINALLY, IT LET ITS CATERPILLAR SKIN FALL TO THE GROUND.

butterfly that so gaily flashed its colours in the sunlight. However, almost as soon as this thought occurs to us, our butterfly begins to grow in beauty before our eyes. Its dumpy wings lengthen out and begin to reveal their charming colours; indeed, the whole process is a delightful transformation scene in miniature. Yet there is no doubt about its reality; there the butterfly hangs on the stem of the plant—a lovely insect that a few moments before was apparently a dry and lifeless object.



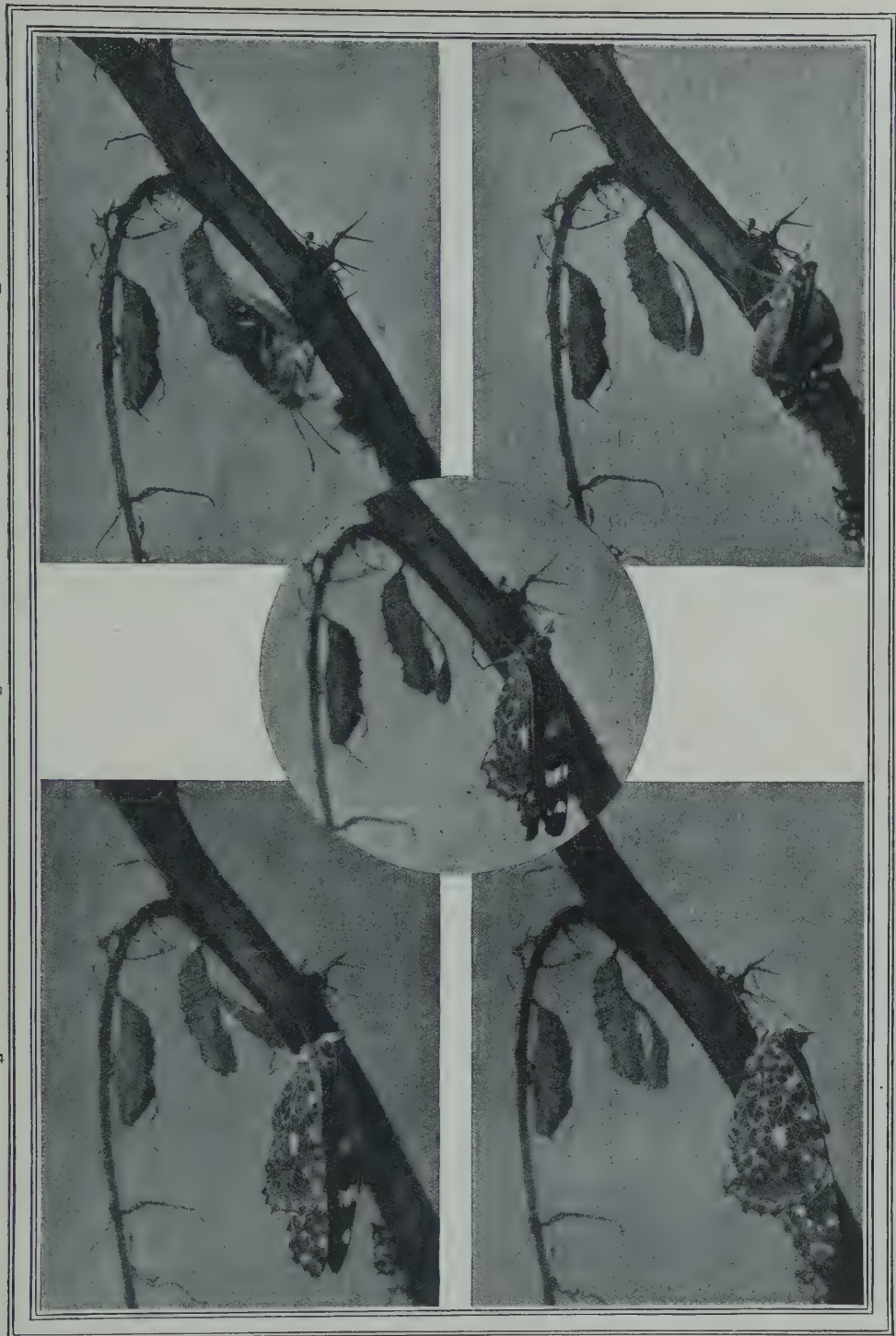
TWO LARVÆ BECAME CHRYSALIDES AT ALMOST THE SAME TIME BENEATH THE CLEANED VEIN OF A THISTLE LEAF.

There, then, the butterfly hung clinging by its legs, its wings dangling in space, for they were limp and wet and quite unfit for flight. At the end of an hour, however, things had changed. It was then obvious that the wings were no longer wet and flimsy, for they had dried rigid and bore quite a trim and neat appearance (No. 5), and they were also under muscular control. This latter fact soon became apparent. It was nearly mid-day, and the bright sunshine was particularly attractive to this creature of the sunlight whose birth we had witnessed. Indeed, its frail form was so crammed with the joyousness of life that it could not afford to waste a moment of the golden time. Instantly the wings

were under control the butterfly became impatient. Its feelers quivered, its legs moved rapidly to and fro, and finally its wings began to flutter; and at the same time the butterfly seemed to realise that it possessed a new and wonderful power. Restraint then was out of the question; away it travelled up the stem (p. 784) to the topmost point, and there it took its first outlook upon the new world of space it had to conquer. The erstwhile caterpillar that filled up every moment of its existence in searching for and devouring green leaves, allowing intervals for resting, was as dead and forgotten as if it had never been. Here was a creature whose food consisted of the sweet nectar of the flowers, and who would never eat a green leaf while it lived, for it lost its mandibles when it threw off its last caterpillar skin, and now it had only a long, coiled sucking proboscis which it unrolled, to search the depths of the flowers. Its outlook on life evidently gave it much satisfaction, for it suddenly opened wide its wings and revealed the lovely colours of their upper surface (p. 784). Where and how it got those marvellous organs with all their wondrous hues was all a mystery. Evidently green leaves were the working basis for their production, yet this knowledge does nothing towards explaining the mystery.

The opening of the wings was but a preliminary movement. After the butterfly had sunned itself for a few minutes, it quietly pushed off from the stem into space. It did not at first fly very far, but after a short rest it again rose on its wings, and then that same bold flight that characterised the parent butterfly when it careered over its selected plot near the sea-coast was reproduced almost exactly.

Yes, our butterfly, at least, was safely launched, but what would happen afterwards? Probably several days would be occupied in the simple pleasures of butterfly life, such as frolics in the sunlight with its brothers and sisters that appear about the same time, and imbibing all the sweet nectars from the various flowers. Or there may be love-making, for any day suitable winds may bring a few or a multitude of its species to its near neighbourhood, and amongst such visitors may, of course, come its mate. As we have seen,



THE BIRTH OF THE PAINTED LADY BUTTERFLY.

1. At the end of twelve days one of the chrysalides suddenly burst open, and the butterfly appeared.
2. A moment later it was on the stem.
3. The butterfly immediately began to grow in beauty—
4. As its wings fell from their folds.
5. At the end of an hour the wings had dried and were under muscular control.



THE BUTTERFLY BECAME IMPATIENT
AND QUICKLY TRAVELLED UP THE
STEM.

the development of the butterfly occupies only about six weeks, so that even in the short British summer there would be time for another generation to appear. Another possible happening is that some day when the brother and sister butterflies are sunning themselves, a strong wind may commence to blow, so strongly that with almost one consent the butterflies will rise and drift before it, and so be carried high and driven onwards and onwards, until at last the strongest fliers of the family that remain will find that the wind has ceased to blow, and that they have come nearer to the earth. So tired are they from their forced flight that they all alight. Of course, they may have dropped in some remote part of Europe or Africa, or elsewhere; but that does not matter in the slightest so long as

nettles and thistles, or other food plants, are to be found there together with warm sunshine—those are all they need.

Perhaps, too, the same strong wind will have brought to the same place others of their species, among whom they will find mates that have also stood the test of a journey; and in this way, by the natural law of heredity, a race of still better fliers will be forthcoming for the journeys of the future. In this manner, from small beginnings, the species may have developed an instinct to fly before a strong wind; and as the species have benefited by the habit (because it extends the area over which the insect is dispersed, and thus enlarges its opportunities in life), so it naturally follows that the habit has become inherent, and thus we find that the Painted Lady can now claim almost the whole world as its home.

JOHN J. WARD.



IT OPENED WIDE ITS WINGS AND TOOK ITS FIRST
OUTLOOK UPON THE NEW WORLD OF SPACE
IT HAD TO CONQUER.





SPRING-TIME.

From the Water-Colour Drawing by P. J. Nafiel in the Victoria and Albert Museum.



THE ELDER HEDGE.

HOW TO KNOW THE FLOWERS OF THE HEDGES

By the Rev. H. PUREFOY FITZGERALD, F.L.S.

Illustrated with Photographs by HENRY IRVING

THE Blackthorn, or Sloe (*Prunus spinosa*), is one of the first of the bushes to put forth its blossoms. As Gilbert White remarks, "This tree usually blossoms while cold north-east winds blow; so that the harsh, rugged weather obtaining at this season is called by the country people 'blackthorn winter'"; so that this flower is said to mark the division of the seasons—the end of winter and the live spring. The bark is of a blackish tint, and its common name is derived from this fact, so as to distinguish it from the Whitethorn, or May,

which flowers later and whose branches have a much lighter tint. Towards the end of March, then, or, at any rate, quite early in April, the pure white blossoms of the Blackthorn should be found in the hedges, frequently before the leaves have begun to develop; the flower will be seen to resemble that of the Wild Rose.

The ends of the short branches are very pointed and thorny, and the plant must be handled with care. The leaves begin to develop generally before the flowers have withered, and the fruit is a small, globular, black plum, covered with a

beautiful purplish bloom when ripe ; this has a very inviting appearance, but a very sour and bitter taste, until a good frost has had an effect upon it, when its taste is not unpleasant. The Blackthorn has given rise, by long cultivation, to the



THE HAWTHORN.

Bullace, Damson, and the different varieties of Plum, to be found in our gardens, and on this account a deep debt of gratitude is owing to it. Many country people make a pleasantly flavoured wine from the fruit—winterpick wine, as it is called—and sloe gin is a well-known liqueur. Not very many years ago it was stated on good authority that much of the China tea of those days was made from the leaves of the Sloe.

THE HAWTHORN

This plant is a near relation to the Blackthorn, both of them being of the Rose family. The Hawthorn (*Crataegus monogyna*) is also called May, or White-thorn, the latter name referring to the lighter colour of the bark as compared with that of the Blackthorn. It is easily distinguished from the latter by its flowering season being later (it is seldom to be seen in bloom before the middle of May), the flowers being larger and fragrant, appearing after the foliage is well advanced. In the Blackthorn, also, the flowers are either single or in pairs, spreading along the branches; in the Hawthorn there are many blossoms on the same level, although their stalks start from different points, yet the whole appearance is more of a bunch. The foliage, again, is very different, for the leaves of the May are divided into segments which are irregularly toothed, while those of the Blackthorn are not divided, being of an oblong shape with the edges very finely but regularly toothed. In the autumn the flowers are succeeded by the well known red haws, which are a great source of food for the small birds during a hard winter. The word "haw"

is a corruption of the old Anglo-Saxon for hedge.

THE BRAMBLE

Very few people will need an introduction to the Blackberry, or Bramble (*Rubus fruticosus*), as it is to be found in hedges and waste places everywhere. To the botanist, however, it is a most puzzling plant, as there are so many species and varieties which are very difficult to distinguish; at the present time there are



THE BRAMBLE.

115 species that are known to grow in the British Isles, and that is not taking into account any of the varieties.

The Wild Raspberry, from which the garden varieties have originated, is a species of *Rubus* (*R. Idæus*) which is frequently met with; the Dewberry (*R. cæsius*) looks like a luxuriant variety of the ordinary Blackberry, but it is a distinct species, and may be distinguished by the fruit being covered with a beautiful bloom, giving it a very rich, inviting appearance and a blueness in colour which is wanting in the ordinary Bramble fruit. The Blackberry flowers do not appear to store any honey, but they are very much visited by insects for the sake of the

quantity of pollen borne by the stamens, so that cross fertilisation very frequently takes place.

SPINDLE-TREE

The Spindle-tree (*Euonymus Europæus*) is a shrub which is more noticeable in the autumn than at any other time, on account of its brightly coloured fruit. This is the only British member of the Celastrus family; it is a smooth shrub, growing from some five or six to twenty feet high, with ovate, finely-toothed leaves. The flower stalks bear from three to five small, yellowish-green flowers, in May, which are not at all conspicuous; and in September the curiously shaped seed vessels ripen, remaining till long after the foliage has dropped off. These seed vessels, or capsules, are of a bright, rosy-pink colour, and are generally of a quadrangular shape, each of the four lobes containing a seed covered with an orange-red covering. Dyes of three distinct



THE SPINDLE-TREE.

colours—red, yellow, and green—are made from the fruit and seed. When fully ripe these capsules open, and the four lobes separate, exposing the orange-skinned seeds. In this state it looks very much like a flower, with pink petals and orange stamens and pistil.

The wood of the tree is very hard, and



PRIVET FLOWERS.

is useful for many purposes. Spindles or skewers are made with it, and this gives rise to the French name for it, *Fusain*. The local names, Prick-wood, or Prick-timber, has also the same reference. A special sort of charcoal for artists is made from the wood, as the lines which it makes are easily effaced. The other French name for it is *Bonnet du Prêtre* (the Priest's hat); this is given to it on account of the shape of the seed capsules.

The name of the Dogwood (*Cornus sanguinea*) does not refer to the animal, but

to the fact that skewers are made from the wood; the prefix "dog" is a corruption of the old English *dagge*, meaning a dagger. Other local names for it are Prick-wood and Skewer-wood. This is a very common shrub in hedges and woods, and may be distinguished readily by the dark red colour of the young branches, and in the autumn by the beautiful crimson colour of the leaves just before they are ready to fall. The shrub grows to a height of five or six feet, sending out a good many branches; the bark is grey, and the young shoots red. The flowers are small, greenish white in colour, and with a somewhat disagreeable scent; there are several flowers in a cluster.

A good deal of honey is secreted at the base of the pistil, and the flowers are visited by all kinds of insects, especially flies. In the autumn the blossoms are succeeded by clusters of very dark purple—almost black—berries. These are very bitter to the taste; they contain a quantity of oil, which is sometimes used for burning in lamps and also in soap manufacture. The leaves give a wonderful gradation of colour, from green to dark crimson, and in this respect resemble the *Euonymus*; several very ornamental *Cornel* trees have been introduced of late years into England from North America. The name *Cornus* comes from the Latin *cornu*, a horn, and was given to the

shrub because of the horn-like nature of the wood.

THE ELDER

A small, much branched tree very often to be seen growing in hedges and thickets, is the Black Elder (*Sambucus nigra*). It belongs to the Honeysuckle family (*Caprifoliaceæ*), although it seems at first sight to have very little in common with the other members of the family. The leaves are pinnate, cut into five or seven segments, sharply toothed, and quite smooth. The cream-coloured flowers are borne in a big flat cluster, about six inches across,



THE BLACKTHORN.



DOGWOOD.

each little blossom possessing a five-cleft calyx, a five-cleft corolla, five stamens, and three stigmas; this is succeeded by a round, one-celled black berry, very much the same size as a buckshot. The bark of the old wood is greyish yellow, whilst that of the young shoots is green. Both the stems and the branches are full of a light, spongy pith, which can be easily removed, leaving the hollow stem, well known to boys for making whistles and popguns.

As to the origin of the name Elder, Prior states that the word is derived from the Anglo-Saxon *æld*, meaning to kindle, "A name which, we may suppose that it acquired from its hollow branches being used, like the bamboo in the tropics, to blow up a fire." In old times the tree was supposed to have great medicinal properties, and a perfumed liquid, called Elderflower water, was made by distilling the flowers with water and alcohol.

In many country districts Elderflower wine, and also Elderberry Wine, still are made in considerable quantities. It is said, too, that the juice obtained by pressing the berries was, at one time, largely used in adulterating foreign wines.

No honey is secreted by these flowers, but there is a very sweet scent which serves to attract insects.

PRIVET

The Primprint, or Privet (*Ligustrum vulgare*), is a common shrub, the more so because it is largely used for making hedges. It, like the common Ash, is a member of the Olive family (*Oleaceæ*). The leaves are opposite, and all of them smooth and undivided, and nearly evergreen. The white flowers are borne in short panicles or bunches at the ends of the branches, and have a faint, sweet smell; these are succeeded in the autumn by purple-black berries, which remain on the shrub for the greater part of the winter or until they are demolished by the birds. The name Privet is a corruption of *Prymet*, which in its turn is derived from the French *Prime Printemps*, a name formerly given to the Primrose. Dr. Prior states that the generic name, *Ligustrum*, was at one time applied to the Primrose, but that it was afterwards transferred to this shrub—hence the confusion in the names.

H. PUREFOY FITZGERALD.

THE VOICE OF NATURE

Some reflections on the young life of early summer

By BENJAMIN HANLEY

Illustrated with photographs by the Author

SO far as young bird life is concerned June is the richest month of the year. In the hedges flocks of young starlings multiply, chattering and screaming, day by day; families of warblers, newly fledged, creep through the tangled thickets; young tits go piping through the woods in single file; and the early plovers gather into flocks. But the nesting season does not end with June, for many partridges have, as yet, scarcely finished laying their clutch of olive-tinted eggs; the yellow-hammer, whose jingling trill is heard all day by the wayside, and the corn bunting, who imitates

his cousin's song, but is never able to give it the finishing note, have, as yet, hardly thought about nest building. By the breeding grounds of the lapwings, too, should any robber gulls put in an appearance, the wild yet musical "willow-weet-pee-wit" of the protesting plovers tells one that there are still eggs and brooding females to be protected; and to judge by their calling, the land-rails have barely got used to each other's company, and the nest is not yet made. So that even in June, rich as it is in young bird life, one may find numerous eggs.

Playing around the mouths of their

TREES

THE CONIFERS

Specimens required :—BRANCHES, CONES OF SCOTCH FIR,
CATKINS AND SEEDS

The Tree

Note :—

- (1) Shape of tree : main trunk is tall and straight, shape of tree is conical.
- (2) Mode of growth of branches : horizontal.
- (3) Roots and nature of soil on which the tree grows.

The Leaves

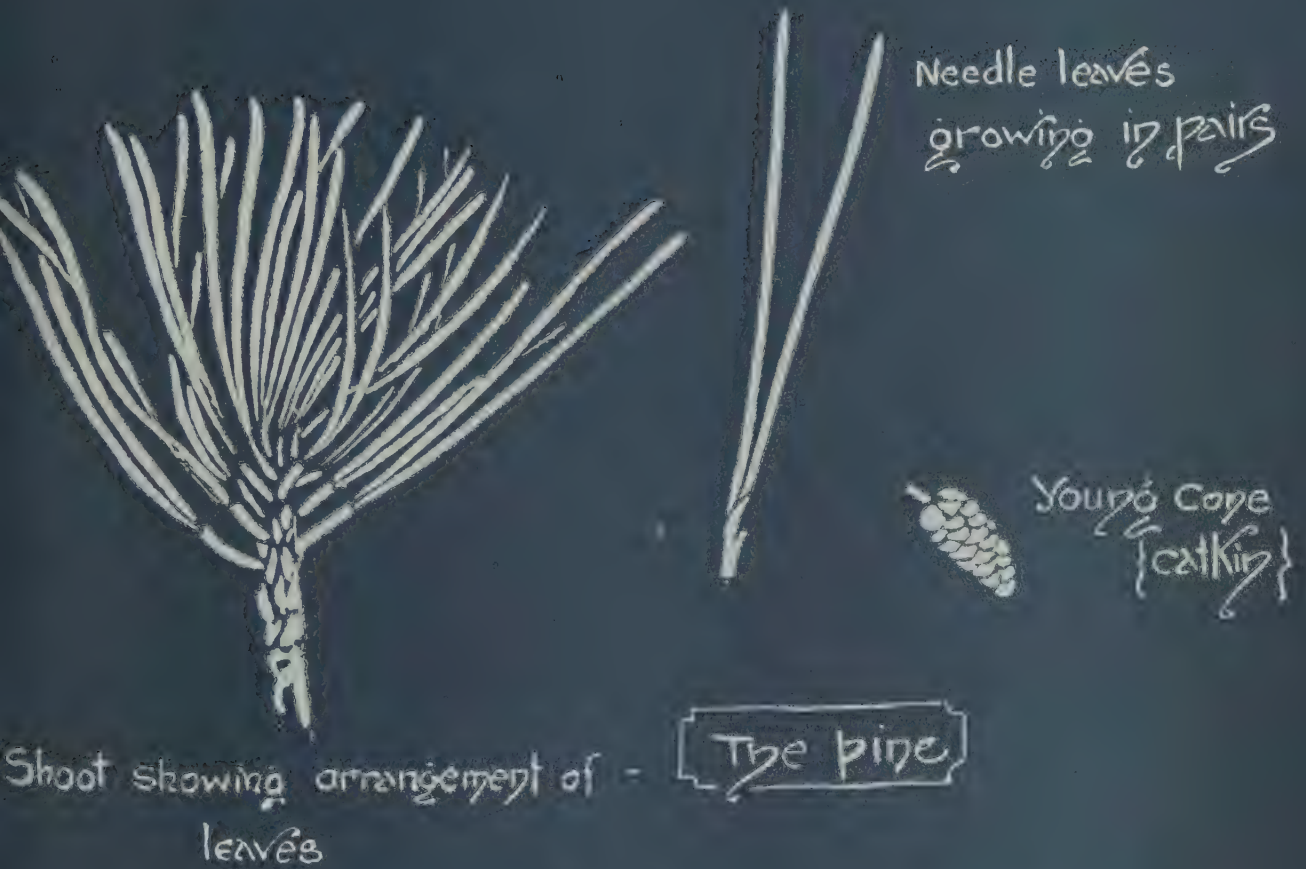
Note two kinds :—

- (1) Scaly leaves on branches.
- (2) Needle leaves of the foliage. These grow in pairs.

Cones and Catkins

Note that the catkins with stamens are covered with pollen, which is shaken from the tree by the wind. The catkins with pistils receive pollen and form cones. The cones contain winged seeds which are dispersed by the wind when ripe. Collect cones and hang them up. Note subsequent opening of cone and flight of seeds.

Cone bearers - CONIFERS



The cone bearers are EVERGREENS except in the case of the Larch.

The cones contain the seeds which are winged.

The leaves are of two kinds:- scaly leaves on the stem - needle leaves.

The wood is valuable.

retreats young rabbits by the score may be observed. They have many endearing ways, and one's heart instinctively softens toward them when, from some point of vantage on a sunny afternoon, they are seen daintily performing their elaborate toilet, often assuming attitudes and poses so comical and grotesque that one is obliged to laugh, and then an array of white tails bobbing for shelter as fast as legs can carry them is seen. After a few moments one pair of sharp little eyes after another will peep out until they are all once more enjoying the sunshine, and on the watcher continuing his way, scamper off again to their underground homes.

As summer advances, the air grows thick with insects of all descriptions, varying in size from the largest dragon-flies to tiny microscopic creatures beyond the ken of our naked eyesight.

Butterflies flutter aimlessly from flower to flower; dragon-flies dart swiftly to and fro on gauzy wings, glistening and shimmering in the sunlight; humble bees buzz lazily by, overtaken by the more energetic hive bees and wasps; bluebottle flies bask in the sun, and ichneumon flies flit quickly past on the lookout for the larvæ of other insects, in order to deposit their eggs in the unlucky grubs, or near them.

What a freshness there is after a sudden shower, when the land is all but baked by the heat of the sun's rays! The old-fashioned sweet-briar especially fills the

air with its fragrant perfume. The birds, too, seem as if they cannot refrain from singing, and almost every member of the bird world voices its thanks for the refreshing shower—voices widely different, yet blending together in one perfect whole. From all sides the avian music ascends, and there is no difficulty in picking out the

lark's carolling, the thrush's whistling, the blackbird's piping, the cuckoo's calling, or the sedge-warbler's inimitable chattering, from the sweet chorus.

June is rightly named the month of flowers; for never is such a wealth of bloom to be found any other month—turn which way you will flowers innumerable greet the eye. The hazel-leaved blackberry, which blooms later than the dewberry and earlier than the common bramble, is now in flower, and



A YOUNG SPARROW-HAWK.

often, too, from the tangled bramble bushes the woody nightshade thrusts forth its climbing stalks, hung at intervals with clusters of purple flowers, each with a yellow centre. In the lanes the wild rose is in full bloom and makes a star-spangled banner of the hedgerows, whilst the honeysuckle—sweetest and best beloved of all—is beginning to open, and will soon tempt the nectar-loving insects to gluttony. Along the banks and in the meadows the most common flower of all is the dainty bird's-foot trefoil—"lady's fingers" the children call them—and near by one is almost sure to find the trembling or quaking grass, which verily seem, like the leaves of the

aspen, as if they were never still. The pink and white champions grow on all sides, and in the bottom of the hedges the white blooms of the greater and the tiny, starry flowers of the lesser stitchwort may be seen. Along unfrequented pathways by the streams the large spreading leaves of the butter-bur, which masters of the brush love to include in the foreground of their pictures, seem to smother everything but the pinkish-white flower discs of the cow-parsnip topping its three feet of stalk; but lovely above all others is the meadow cranesbill, with its large purple-blue flowers of almost unpaintable hue. The elder bushes are decked with flat discs of creamy white flowers, and from a distance the guelder rose bushes appear similarly garbed; but in the case of the latter, large and small flowers are borne on the same stalk—the larger flowers being barren and placed round merely as an attraction for insects.

Words fail to picture the delights of a June evening when the sun, after shining for sixteen long hours from a cloudless sky, is slowly sinking beneath the western horizon—a great red ball of fire. The whole countryside presents a scene so peaceful that it baffles description.

The cuckoo calls from an oak tree near by, and soon evokes an answering note from a couple of fields away; the musical "tur-tur" of the turtle-dove comes from the

distance, and from the other side the more pronounced cooing of the wood pigeon; from amongst the rushes and sedges by the water-side the moorhen croaks, and the water vole rustles his way through the dry reed stems. Twenty or thirty yards away the head and ears of a hare appear as she sits on her haunches to peep above the growing corn; hedge snails are feeding upon the vegetation, and through the grass many black slugs make their way. An occasional beetle flies past with murmurous droning; various moths come from their daylight resting-places, and the little pipistrelle bat issues forth to flicker to and fro with seemingly uncertain flight. The shrew squeaks shrilly in the grass, and enow the king of the night folk—the barn owl—sails around on silent wings, presently giving vent to such a weird, uncanny scream as must surely blanch with terror the hearts of all rodents starting on their nightly prowls, and send them scuttling off home again in no uncertain manner. From a wood over the way comes the loud cry of a startled pheasant, and as if to follow his example, a blackbird flies hurriedly out of the bush where he obviously intended roosting, with noisy cackle, and the sedge warbler, which had settled down for a time, breaks out anew to chatter and scold for all he is worth.

BENJAMIN HANLEY.



A YOUNG CUCKOO.

HOW TO KNOW THE WILD ANIMALS

By DOUGLAS ENGLISH, B.A., F.R.P.S.

Author of "Wee Tim'rous Beasties," "Beasties Courageous," etc.

THE BATS

With Photographs by the Author

IT was not without reason that mediæval artists, when faced with the necessity of raising devils from their inner consciousness, should have invested them not only with the wings, but also with the countenances of Bats.

So far as facial beauty was concerned it might have proved difficult to appraise the claims to distinction of the various Orders of animals; to differentiate, for example, from an æsthetic standpoint, between a Squirrel, a Hedgehog, and a Stoat. In the case of facial ugliness there seems to have been no such difficulty. Mediæval artists accepted Bats as the *ne plus ultra*, and their view was adopted by artists of the Renaissance. In Dürer's "Knight, Death, and Satan," the countenance of the Fiend, though of a somewhat composite character, appears to be modelled on that of a Bat of the genus *Megaderma*; while another familiar mediæval devil, who possesses a pair of projecting tubular nostrils over a grinning, thin-lipped mouth, reminds one strongly of the genus *Harpyia*. Both these genera of Bats may well have come within the experience of mediæval travellers, and it is not unlikely that the reminiscences of the latter may have pointed morals or adorned tales, in which the primal contrasts between "light" and "darkness," and between "good" and "evil," were regarded as synonymous.

As Ingersoll puts it: "While the graceful pinions of birds have been given to angels of light, the leathery and angular wings of the Bat have been used by painters and sculptors to signalise the forms of fiends."

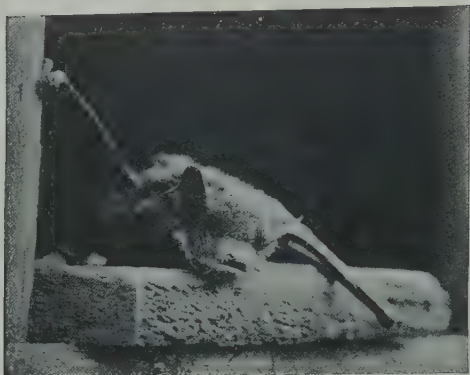
It must not be supposed, however, that *all* Bats are hideous. Several of

the large fruit-eating Bats, those known as "Flying Foxes," for example, have agreeable vulpine faces, while the majority of our twelve British species may be described as being, for Bats, passably good-looking.

The extreme of Bat ugliness is reached in what are known as the Leaf-nosed Bats (*Rhinolophidæ* and *Phyllostomatidæ*), and is due in the main to an extraordinary fleshy outgrowth surmounting and surrounding their nostrils. This outgrowth, though symmetrical about the centre line of the face, presents remarkable specific variations of pattern. In conjunction with diminutive eyes, impish ears, glandular protuberances on the cheeks and muzzle, and a gaping bare-toothed grin, it ensures an expression of countenance for which "demoniacal" is the only fitting term. The *Phyllostomatidæ* (Vampires) are not represented in this country, but we have two representatives of the *Rhinolophidæ*, who, from the formation of their nose-leaves, are known respectively as the Greater and Lesser Horseshoe Bats.

The function of the nose-leaf, of which traces are to be found in certain Insectivora, as well as in Bats belonging to families other than the two just mentioned, is unknown. The old theory that it was in some fashion a sense organ has been materially weakened by recent investigations into its structure, while its superior development in male Bats suggests that it may be nothing more than a sexual adornment. Against this must be put the fact that the "leaf-nosed" Bats are the most highly organised of the insect-eating, as opposed to the fruit-eating members of the Order. They are

distinguished by a peculiar neatness of flight—Mr. Coward describes the Lesser Horseshoe Bat as turning in the air



THE SEROTINE.

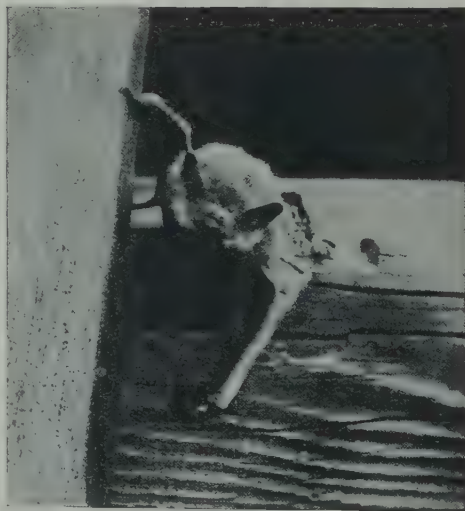
Noticeable points are the pad at the base of the thumb—which is possibly the remnant of a sucker—and the triangular naked patch in the centre of the under lip.

immediately before alighting, and so avoiding the laborious reversal which is necessary in the case of Bats which alight head upwards—and one would naturally expect to find in Bats so distinguished some clue to the nature of that delicate sense-perception which is characteristic of Bats in general, and whose existence, first investigated by the Abbé Spallanzani, has been confirmed recently in this country by Mr. A. Whitaker. In Spallanzani's experiments specimens of the Noctule, the Long-Eared, and the Greater Horseshoe Bats were completely blinded, and deprived, as far as was possible without killing them, of the senses of smell and hearing. They were then "set at liberty."

"It was discovered that under these conditions they could conduct their flight through subterranean passages without striking against the walls, that they turned exactly as the most complicated windings required, and that they even avoided, with great exactness, cords, branches of trees, and other obstacles."

Mr. Whitaker's experiment is described by Millais as follows: "He obtained a Natterer's Bat and covered its closed eyes with wax, fastening it with a little patch of rubber and solution, and then released the Bat in a room in which it had not been before. When, on previous

occasions, other Bats had been at liberty in this room they had usually circled round close to the ceiling; but this blinded Bat at first flew in a hesitating manner, and then, gaining confidence, went straight towards the closed door. It stopped when about six inches away, and hovered slowly along the line of the top and right down the side, without doubt keeping its position through its sensitiveness to the slight draught which came through the tiny chink. Finding no opening large enough to get through, it flew quickly down the room towards the fireplace, no doubt again feeling the draught, but turned away when it felt the heat of the fire. It flitted then close to the wainscot, hesitating repeatedly at a spot where the woodwork was a little sprung and there was again a sensible draught. It flew quickly, passing under chairs, of which there were twelve in the room, besides other furniture, and never even touched anything with the tips of its wings. An attempt to catch it showed that, although incapable of sight, it was well able to dodge; but it constantly



THE PIPISTRELLE.

The small common Bat.

stopped in its flight, hovered, and scratched at the covering over its eyes. When a stick was held in its direct path it avoided it when three or four inches away. When it wanted to rest it settled on one of the

weights of a gas chandelier in quite an orthodox manner, and when a hand was stretched out to capture it, it flew off again before it was touched. . . . The animal's sight was in no way injured when the wax was removed."

It would appear that the object both of the Abbé Spallanzani and of Mr. Whitaker was to prove that the absence of actinic light has little, if any, effect on the ability of a Bat to avoid obstructions in its line of flight.

This fact can be more simply and more humanely determined by confining oneself in company with a lively Bat in a small darkened room, and creating such obstacles as may seem desirable by a suitable disposition of oneself and of the furniture. If the darkness is complete, and the silence is complete also, it will be found that one's own sense perceptions (other than that of sight) are so sharpened as to enable one to determine certainly, after a little practice, whether the Bat is flying, resting, or scrambling about. As a ready means of confirming or refuting one's first impressions an electric pocket lamp is useful. One "feels" the approach of the Bat to one's face, and one "feels" it sheering off. One "hears" the interruptions to its flight. More than once, under such conditions, I have known the Bat to settle on my clothing, on my outstretched hand, and even on my head, but this has never been with the force of a collision, and it seems reasonable to conclude either that a Bat's eyes are sensitive to rays which are invisible to human beings, or that the Bat possesses some sense-perception which is independent of vision, and is infinitely more delicate than the similar sense-perception which we ourselves may experience under suitable conditions. It seems likely that this sense-perception may be governed by delicate atmospheric impressions—temperature, resistance and elasticity of the air, draught, moisture, and so forth—and that it may be in some way connected with the innumerable "sense-hairs," which are to be found about a Bat's muzzle, on his ears, and scattered over the relatively enormous surface pro-

vided by his wings. It should be remembered in this connection that each "sense-hair" contains a nerve-fibre.

The wing-structure of Bats is unique. In several of the so-called "flying" animals (Flying Phalangers and Flying Squirrels, for example) an expansion of hairy flank-skin connects and includes the main portions of the limbs on either side of the trunk, but leaves the hands and



THE NOCTULE.
Earlet (Tragus) can be seen plainly.

feet free. The horizontal extension of the limbs stretches this integument into a four-sided sail, and, trusting to its strength as a parachute, the "flying" Squirrel, or Phalanger, is capable of executing prodigious leaps and long aerial glides. The "Flying Lemur," or Colugo, is still further specialised. His feet, hands, and tail are included in a similar parachute membrane, leaving only his muzzle and claws free. Wallace has described him as gliding obliquely downwards through the air for a distance of seventy or eighty yards, and as being capable of steering a definite course. In none of these "flying" animals, however, are the limbs markedly abnormal in structure, and the height to which they can rise in the air is limited to their leaping power.

In the Bats, on the contrary, we find a genuine power of flight, and a corresponding modification of structure. The

upper arm bone (*humerus*) of a Bat is abnormal, the chief fore-arm bone (*radius*) more abnormal, and the finger bones most abnormal of all. The peculiarities of these bones may perhaps be best realised by comparing their proportions with the proportions of the corresponding bones in ourselves. Though the latter may exhibit considerable variation in different individuals, it may be said that in the average human male the distances between the breast-bone and the shoulder-joint, the shoulder-joint and the elbow, the elbow and the wrist, and the wrist and the middle finger-tip, are roughly in the proportion 3:6:5:3. In the Long-Eared Bat the corresponding proportions may be taken as 1.4:3:5:8.

If we were in imagination to set ourselves the task of converting a human fore-limb (seven inches, say, from breast-bone to shoulder, fourteen from shoulder to elbow, eleven from elbow to wrist, and seven from wrist to middle finger-tip) into a fore-limb of similar proportions and structure to that of a Long-Eared Bat; if, that is, we were to endeavour so to modify a human skeleton that its owner might have reasonable prospects of being able to fly, we should find that, to begin with, the following extensions would be necessary. Leaving the collar-bone at seven inches, the upper arm bone would have to be lengthened to fifteen inches, the fore-arm to twenty-five inches, and the middle finger-bones to forty inches. The limb, that is, outside the trunk, would have to be extended to two and a half times its previous length. The thumb might be left at seven inches in length, starting from the wrist, but would have to be armed with a prodigious claw. The fingers, varying from twenty inches to forty inches in length, would have to be connected with each other, with the inner surface of the arm bones, with the side of the body, and with the outer surface of the leg bones (as far down as the ankle), by an elastic folding membrane richly supplied with nerves, muscles, and blood-vessels. When the arm was extended outwards and the fingers opened fan-wise this membrane would cover an area of about thirty square feet, and an additional spread of sail would be secured by a triangular membrane whose apex

was at the elbow-joint and base a line connecting wrist and shoulder, and also by a membrane connecting the inner surface of the leg bones as far as the ankle with a prolongation of the vertebræ in the form of a tail. The total wing area on both sides of the body might be as much as eighty square feet, but even this would hardly support more than a tenth of the original weight. The latter would have to be enormously lessened, by a re-arrangement and lightening of bone and muscle, before our human Bat could fly. He would have to develop a hump-back and a pigeon-chest. His neck vertebræ would have to describe a S-shaped curve so that the back of his head might nestle between his shoulder-blades. Several of his skull bones would have to be reduced to cartilage. His breast-bone and ribs would have to coalesce for the support of his pectoral muscles. His pelvis and lower limbs would have to be greatly reduced, and his thigh-bones would have to be rotated at the hip-joints in such fashion that his knees were directed backward—a position, it may be noted, which is aspired to by those who would skate the "spread-eagle." Finally, the folds of his ear would have to be ironed out and pulled upwards so as to form a conch nearly a yard in height, and his tragus (the small projecting lobe which is directed from front to back across the ear-opening) would have to be lengthened in the same direction for about a foot.

The necessities of an aerial existence of which the wakeful portion (often limited to an hour or so per diem during favourable conditions of weather) is spent in the incessant pursuit of flying insects have naturally influenced the domestic economy of Bats. They pair normally in late summer or autumn. Shortly after this hibernation may ensue, and the young may not be born until May or June of the year following. Hibernation naturally overtakes their growth, and they are not mature for a twelvemonth. It is rare for more than a single infant to be produced at a birth, for the excellent reason that the mother carries her infant about with her in flight, and tends it unceasingly until, when perhaps a month old, it is fit to catch flies for itself. It clings to her



A PAIR OF NOCTULES.

fur partly by the thumb and foot claws, and partly by the milk teeth, whose recurved and often bifurcated points are singularly well adapted for the purpose. The infant Bat is blind and practically naked, while immature Bats of the year are usually markedly different in colour from Bats of the previous generation. It is probable that from, say, May to August the females congregate apart from the males so as to have the control of their family affairs undisturbed, but, during hibernation, Bats of both sexes, and often of several different species, may be found by the score in suitable retreats—caves, ruins, hollow trees, and so forth.

The duration and profundity of their winter sleep is dependent on the temperature of their immediate surroundings, and if, as seems likely, the crowding of Bats during hibernation maintains this temperature at such a height as to prevent complete torpidity, their jostlings, changes of position, and, as Millais happily puts it, "seething," may be easily accounted for. The Noctule, Serotine, Pipistrelle and Long Eared Bat may be considered "light" sleepers. The fact that a hibernating Bat, or a Bat that has been reduced to a comatose state by the vagaries of our English summer, feels damp as well as cold may, perhaps, be due to the numerous secreting glands on a Bat's body. To such must certainly be attributed the singularly noisome odour which several of our Bats, notably the Noctule and the Serotine, diffuse at random.

All British Bats are insectivorous, and not only the character of their flight—which, be it noted, is a most difficult and uncertain criterion for distinguishing

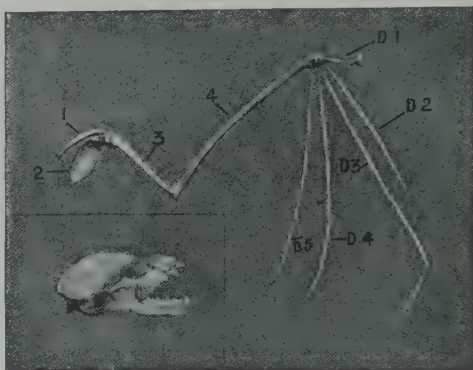
the species—but also the heights to which they ascend, and the localities which they affect, are determined by the flight and distribution of the insects on which they are feeding. I have watched Noctules hawking a hundred feet up where it was impossible to determine with a glass what they were after, and I have seen more than twenty of them together not more than twenty feet from the ground, engaged in annihilating a brood of the smaller stag-beetle (*D.*

parallelopipedus) whose first experience of a free-flying existence was terminated almost before they had quitted the decayed walnut trunk which for some years had provided them with food and shelter.

Although I watched this episode with keen attention, I was unable to detect a single instance of a Bat "pouching" its victim. More than one observer has described a manœuvre by

which captive Bats make use of their interfemoral (tail) membrane in order to secure a hold of a refractory moth or beetle, and one would have thought that a beetle of the size of *D. parallelopipedus* would have necessitated some such expedient.

As it was, however, the Bats seemed perfectly satisfied with two or three sharp and audible crunches, after which they allowed what was left over to drop from their mouths. The ground beneath them was strewn with legs, wing-cases, and insect remnants generally. Occasionally a whole beetle would come down, and two or three of those which I picked had been practically bitten in half. It is, of course, possible that an *embarras des richesses* had in this case disturbed the normal order, but I am inclined to think



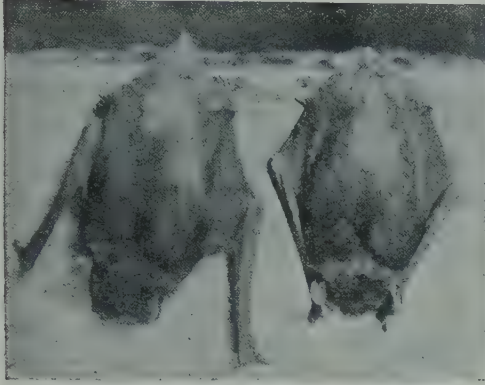
FORE-LIMB ($\times \frac{2}{3}$) AND SKULL (NATURAL SIZE) OF LONG-EARED BAT.

1. Collar bone (clavicle).
2. Shoulder blade (scapula).
3. Upper arm bone (humerus).
4. Fore-arm bone (radius); the ulna is merely a splint.
- D 1. Thumb (pollex). D 2, 3, 4, 5. Fingers.

The thinness of the bones composing the skull can be judged from the fact that the roots of the teeth in the upper jaw can be seen through them.

that "pouching" is only possible in the case of "arboreal" Bats who can steady themselves by clinging to bark or foliage during the operation.

I am equally doubtful as to the possi-



A PAIR OF NOCTULES.

The one on the right is in the normal head-downwards sleeping position. The one on the left is commencing to bestir himself, the first step being a slow movement of the head from side to side, and a groping for foothold with the thumbs, preliminary to launching into the air.

bility of a Bat using the interfemoral membrane as a rudder. A Bat's hind-legs are kept stiff in flight, the movement of the wings being from the shoulder-joints, and in most British species the tail is recurved towards the belly. It is conceivable that the pouch so formed may serve as a brake when the Bat dives; and that a moth or beetle missed by the Bat's teeth may on occasion get caught up in it. I am inclined, however, to doubt the likelihood of a Bat flying for any distance with his nose jammed against his tail, as would necessarily be the case if the tail membrane were used as a feeding trough.

In any movement but flight Bats appear to singular disadvantage. Their progress is impeded by the spread-eagling of their legs, by the disproportionate length of their arms, and by the continuity of the membrane between their legs, arms, tail and trunk. In scrambling they advance in order: (1) the fore-limb until the thumb-claw is engaged, (2) the hind-limb on the same side of the body, (3) the opposite hind-limb,

(4) the opposite fore-limb, and so *da capo*. The pace to which they attain by this awkward lopsided shuffle is remarkable, while the ease with which many Bats can soar from the flat is astounding. If by any mischance a Bat finds himself in water, he "rows" himself clear with his wings.

One would have supposed that Bats would often be taken by owls. This, however, seems to be an infrequent accident, and it is possible that owls have learnt by experience that the nutriment contained in a Bat is disappointingly small. I have often picked up moribund Bats who showed clear signs in the shape of broken wing-bones, slit ears, and so forth, of having received rough treatment. One can seldom do much for them. I endeavoured on one occasion to set the broken radius of a Serotine, putting it in miniature splints and securing these by silk passed through the wing membrane. Although at the commencement of the treatment the animal appeared to be in excellent condition, he refused food and died five days after I had picked him up. I was unable to satisfy myself that the broken bones had in any way tended to unite. During the actual setting of the fractured bone the poor brute's screams were piteous in tone and of an entirely different quality from that needle voice of Bats which is strident to the hearing of some human beings and imperceptible



THE LONG-EARED BAT.

The wonderful ears are semi-transparent, and when viewed against the light form a beautiful object, often of a delicate pink colour.

to that of others. A Bat's normal squeak can be perfectly imitated by striking the edge of a sixpence against a penny.

The subjoined list is based mainly on the writings of Johnston, Millais, and H. E. Forrest.

GREATER HORSESHOE BAT.—Nose-leaf. Pointed ears. Straight tail. Length (nose-tip to tail-tip) about 4 in. Wing stretch $10\frac{1}{2}$ in. Adult red- or grey-brown above, grey below. Immature, grey. Females sometimes golden brown. South and especially S.W. England.

LESSER HORSESHOE BAT.—Nose-leaf. Pointed ears. Straight tail. Length about 3 in. Wing stretch $8\frac{1}{2}$ in. Grey-brown above, grey below. Immature, grey. Distribution similar to above, but has been recorded from N. England and Ireland. At rest both the Horseshoes shroud themselves completely in their wings, and resemble chrysalides.

BARBASTELLE.—Ears high and broad, indented on outer, almost touching at inner margins. Rudimentary nose-leaf. Eye included within the base of the ear. Earlet (tragus) triangular, with semicircular notch on outer border. Length 4 in. Wing stretch 10 in. Blackish or deep red-brown. Hairs light at tips. Sparse white hairs on tail membrane. S. England. Uncommon.

LONG-EARED BAT.—Ears enormous, often folded back at rest, leaving tragus projecting and conspicuous. Rudimentary nose-leaf. Length $3\frac{1}{2}$ in. Wing stretch 10 in. Common everywhere. Arboreal. Often out in day-time.

SEROTINE.—Wing membrane rising from half way up the soles of the feet. Tail projecting naked for $\frac{1}{4}$ in. Size large. Length $4\frac{3}{4}$ in. Wing stretch 12–13 in. Ears almost as long as head. Tragus narrow at base, then widening, then tapering. Dark brown above, dusky

below. Greasy fur. Smelly. Slow, laboured flight on occasion. Often out in day-time. S. and especially S.E. England.

NOCTULE.—Wing membranes rising from ankles. Size large. Length 5 in. Wing stretch 13–15 in., but fingers comparatively short. Ears short. Tragus short and squarish. Rich warm-brown body fur. Smelly. Common in S., rare in N. Unknown in Scotland or Ireland.

LEISLER'S BAT.—Smaller than, but like preceding, and perhaps should be regarded as a local variety. It is said that the lower incisors are more crowded than in the Noctule, and that the hair is lighter at the tips. Takes the place of the Noctule in Ireland.

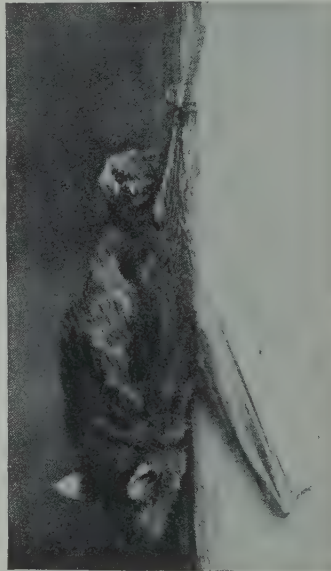
PIPISTRELLE.—The common Bat. Small. Length 3 in. Wing stretch $8\frac{1}{2}$ in. Face covered with short fur. Great variation of colour from russet to pale brown. Thirty-six teeth.

WHISKERED BAT.—Very small. Length $2\frac{7}{8}$ in. Wing stretch $8\frac{1}{2}$ in. Upper incisors diverge laterally. Ears with strong indentation in middle of outer border. Tragus long and straight-edged. Face covered with long hair. Generally distributed. Thirty-eight teeth.

DAUBENTON'S BAT.—Very large feet. Length $3\frac{1}{4}$ in. Wing stretch 9 in. Light-coloured breast. Fond of skimming across water. Generally distributed.

NATTERER'S BAT.—Interfemoral membrane bracket-shaped and its margins bordered with short stiff hairs. Light-coloured breast. Length $3\frac{3}{8}$ in. Wing stretch 11 in. Tragus very long, straight, and sharp. Generally distributed.

BECHSTEIN'S BAT.—Ears large and of a characteristic shape, bending outwards at an angle of 78° and turning upwards to the perpendicular (Millais). Length $3\frac{1}{2}$ in. Wing stretch 11 in. Short tail.



THE SEROTINE.

The extension of the wing membrane beyond the ankle and up to the base of the toes can be seen in this picture.

HOW TO KNOW THE SHRUBS GROWING IN BRITAIN—I

With Notes, descriptive and photographic, for their Identification
in all Seasons of the Year

By HENRY IRVING

THE WILD GUELDER ROSE AND THE WAYFARING TREE

NO very hard and fast division can be made between the Trees and the Shrubs. Some

trees, under certain conditions, or as the result of accident, may assume the shrubby habit ; and some shrubs may, from some predetermining cause, become small standard trees.

The shrubs are those which, by putting up several stems simultaneously, of about equal strength, evince a decided tendency to grow bushy. Generally, also, the lowermost buds on these stems grow out earliest and more strongly, so confirming this habit of growth.

THE WILD GUELDER ROSE

This shrub is classed with the Honeysuckles in company with the Wayfaring Tree, the Elder, and the Snowberry. The chief point they have in common is with respect to the flower, whose five petals are united, forming a tube to which the stamens are attached. This falls away in a single piece. The fruit grows beneath the calyx

as in the Apple group. The buds and leaves are in opposite pairs.



THE WILD GUELDER ROSE.



FRUITS OF WILD GUELDER ROSE.

The Guelder Rose, or Snowball Tree, of our gardens is but a variety, if it were not better described as a monstrosity, of the wild shrub; yet by a curious perversion it has given to this shrub its popular name, Guelder (or Dutch Gelderland) Rose.

The Wild Guelder Rose is found chiefly in moist places. It loves the steep banks of small streams, so growing that its stems are often under water in flood-time. There, in May or June, it displays its platter-like clusters of porcelain-white flowers, supported above the vivid greenery of its newly expanded foliage. Later, on the approach of autumn, more conspicuous still, so long as the birds allow, it is jewelled over with clustered fruits, all ruby-red and brilliant.

From the base it puts up several long and slender stems, a little straggling, the twigs of which are smooth and polished, yellow or brown in colour. The buds, in opposite pairs, are oval, rather fat and pointed. Each is enclosed in what appears to be a single scale, formed, however, by the fusion of two, bright red in colour, and slightly sticky. The leaves, which

are generally rounded at the base, show three or five angular divisions, into each of which a strong rib passes. Each rib radiates from the place of junction with the stalk, and terminates in one of the leaf points. The margins are irregularly toothed. The leaf is thin and smooth, without hairs above, and with few on the under side. At the top of the leaf-stalk are two or more reddish honey-glands, similar to those on the Cherry. At the base of the stalk are two narrow stipules, which also have honey-glands. Lord Avebury suggests that these glands serve a useful purpose in attracting ants and wasps as a protection, or bodyguard, against inroads of caterpillars, especially whilst the leaves are young. In the autumn the leaf colouring is various, and particularly rich, with shades of yellow, pink, maroon and crimson.

The flowers, which are a very clear white, are grouped and flatly extended as those of the Elder. They are borne



LEAVES OF WILD GUELDER ROSE.



FLOWERS OF THE WAYFARING TREE.

at the ends of the shoots. Each has five petals. Only those central in the group are true flowers and have stamens and pistils producing fruit. These, crowded together, are ringed round with sham flowers consisting of greatly enlarged petals, but petals only; an arrangement not found elsewhere among our trees or shrubs, though similar to that of the garden Hydrangea. The one purpose of this outer ring of sham flowers is to render the whole cluster more conspicuous. These enlarged petals act as signal flags for the guidance of insect visitors. Bees come mainly for pollen, but numerous flies sip from the exposed honey store. The Snowball Tree of the garden differs only in having all its flowers sham; all, and not an outer ring merely, exhibiting enlarged petals, lacking vital organs, and producing no fruit. The fruits of the wild shrub, gathered into a rounded cluster, are stone fruits, each with a single stone. Their brilliant ruby ripeness is all too quickly effective, to our liking, in attracting the birds, to the entire despoiling of this shrub's autumn adornment; but the plant's racial necessity is best served thereby through the assured dispersal of the seeds.

THE WAYFARING TREE

Nominally a tree, this can never rank as more than a shrub, though under favourable conditions it may attain a fair height. Closely allied to the preceding, and sometimes spoken of as the Mealy Guelder Rose, it shows marked differences. It loves the drier places, and is usually abundant and flourishing on the chalk. Its general appearance is dusty, and for this reason, perhaps, the title "wayfaring" has been attached to it, as also that of "mealy." Its main stems grow more nearly upright than those of the Guelder Rose, and its stouter twigs, thickly felted with grey hairs, stand out stiffly to right

and left.

The buds, in opposite pairs, have at first two tiny scales, but these fall early, so that practically throughout the whole winter the folded leaves are quite unprotected except by their dense hairy coating. They are long and narrow, and are pressed up against the twig; the form and veining of the folded leaves are quite apparent, and there is even the commencement of a stalk, though not so pronounced as in the buds of the Alder. Terminating some of the twigs are the large, rounded flower buds, or flower-bud clusters, each cluster attended to right and left by an upstanding leaf bud.



FRUITS OF THE WAYFARING TREE.

The leaves are a broad oval, frequently heart-shaped at the base, and pointed at the apex. They are supported by a single midrib with branching secondaries. Their surface is wrinkled, they are thick and velvety, greyish and dusty looking, especially on the under side, where the hairs are thickest. The marginal indent-

flowers, complete in all their parts, none being set apart for purpose of show merely. The fruits, which become considerably bunched, are semi-globular, each being flattened somewhat like a flask. They show great variety of colouring, according to their stage of ripeness, and the incidence of the sun's light, ranging from



LEAVES OF THE WAYFARING TREE.

ations are regular, like the teeth of a saw. The five-petalled white flowers form a rounded cluster after the manner of an inverted saucer. These are all true

creamy yellow to coral pink, through crimson to jet black, all in the same cluster. The birds show them marked attention.

HENRY IRVING.

THE HOUSEKEEPING OF THE HUMBLE-BEE

"Humble Bees are the least civilised of all communal insects"

By HAROLD BASTIN

Illustrated from photographs by the Author

THE hive of the Honey Bee has often been likened to a well-ordered city. The Humble-Bee's nest is a mere establishment—a kind of insect Rowton House. Its internal arrangements are marked by extreme simplicity, while its inmates have a happy-go-lucky

way with them which contrasts strongly with the well-ordered activity of the Honey Bee. Humble-Bees, in fact, are the least civilised of all communal insects. Less civilised are they than the Wasp, although in some respects their habits resemble those of the latter insect.

Like Wasps, the founder of a Humble-Bee colony is a solitary queen, the survivor of the preceding summer, who comes forth from the crevice in which she has hibernated. But whereas Wasps have a definite system of architecture, Humble-Bees have none. Always the interior of the nest presents an irregular appearance.

In Britain we have some eighteen species of Humble-Bees. Some of these build their nests in holes, others upon the surface of the ground beneath a pile of moss or vegetable débris. In all cases, however, the same easy-going methods are in force; so that while the following remarks refer chiefly to a subterranean nest to which the writer paid particular attention, they will also be found to apply, in the main, to such

material of their own making. In the centre of the chamber is the nest proper—a mass of yellowish objects not unlike small snakes' eggs. These are the cocoons, or cradles, formed by the Bee grubs prior to their period of pupation. At first glance these seem to be huddled together in a sort of hopeless confusion, but a more careful examination reveals a rough and ready method in their arrangement. We notice that the cocoons are in two or three layers. Those forming the foundation have their domed tops removed. Some are empty, but others are filled with a clear liquid which, on being tasted, proves to be honey. The cocoons of the upper layer or layers are completely closed. In each of them a Bee pupa reposes, awaiting the season of its final transformation. The photograph



ENTRANCE TO THE HUMBLE-BEES' NEST.

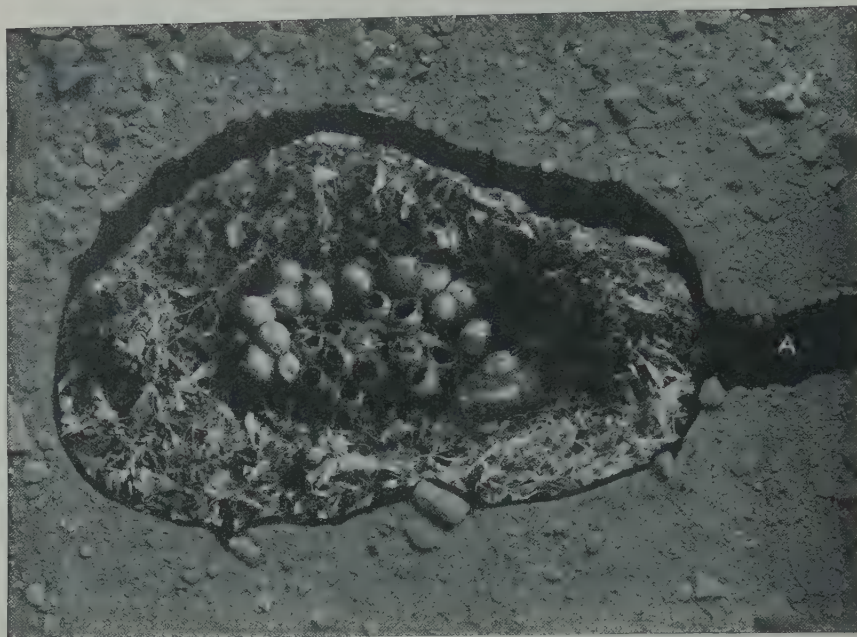
nests as are built upon the surface of the ground.

The home of the Humble-Bee is approached by a tunnel leading into a chamber almost filled with a domed mass of vegetable refuse brought thither by the insects in order that their abode may be dry and free from draughts.

Sometimes this packing of moss, grass and leaves is absent; but in these cases the Bees protect themselves from the possible intrusion of wind and water by stopping up crevices with a waxy

reproduced on page 807 will enable the reader to appreciate the above description.

Winding passages traverse the mass of cocoons, enabling the adult Bees of the colony to pass to and fro about their business. But at first we detect no sign of eggs or grubs—the rising generation, whose presence is naturally anticipated. A closer inspection, however, shows us certain masses of chocolate-brown substance heaped upon the summits of the upper cocoons. The position of several of these masses is indicated



IDEAL SECTION THROUGH HUMBLE-BEES' NEST.
Showing entrance tunnel (A), packing of vegetable refuse, comb of cocoons, etc.

in the accompanying photograph by arrows (p. 807). The smaller heaps each cover four or five shining white eggs; the larger heaps as many hungry grubs.

These strange nurseries are characteristic of Humble-Bee housekeeping. We all know that hive Bees rear their grubs in hexagonal waxen cells, bringing food to the little gaping mouths, just as birds feed their nestlings. But the rough and ready Humble-Bee follows another plan. Let us carry our minds back to the early spring-time, and witness in imagination the origin of such a nest as the one we have depicted. The queen-mother, newly come from her winter hiding-place, seeks out a suitable cavern—her choice often falling upon the deserted home of a field mouse. She then sallies forth to collect pollen and nectar from the flowers; and certain vegetable materials from which she is able to concoct the waxy substance which she employs in cell-making. She then returns to her chosen cavern, and commences to form a waxen cell, roughly spherical, the inner walls of which she coats liberally with honey-saturated pollen. Several eggs are now laid in the cell, which is then completely

closed. The queen's next care is to construct one or two waxen tubs, which she subsequently fills with honey. These reservoirs are drawn from to feed the grubs, especially on rainy days when the queen-mother is unable to gather nectar direct from the flowers.

Not long after the young grubs hatch from the eggs they consume the whole of the food with which their cell is lined; and then the queen-mother conveys more food to the interior by ejecting it from her mouth through a hole made for the purpose in the side of the cell. Moreover, the industrious creature, still labouring alone, forms other cells, and deposits more eggs within them. Yet all the time she must busy herself in collecting food for the young grubs which have already hatched.

As the grubs in each cell increase in size, they push against the soft, waxen walls around them, so that the cell gradually grows into an irregular truffle-like mass. When full grown, each grub spins for itself a cocoon of exceedingly fine silk. These cocoons are spun within the remains of the cell; and the queen-mother (later, her assistants the workers)

scrapes away the wax by which the cocoons are covered. This makes it easy for the mature Bee to escape from the cocoon when its metamorphosis is complete.

The lower photograph on p. 808, which is considerably magnified, will give an idea of the appearance of the Humble-Bee's egg, and of the grub (or baby Bee) during several of the earlier stages of its existence. The upper photograph (proportionately enlarged) shows us the dorsal view of the Humble-Bee pupa. One is able to distinguish the larger divisions of the body—head, thorax, and abdomen; also to note that the wing rudiments are folded at the sides, towards the ventral aspect of the pupa, just as is the case with a butterfly chrysalis. Later on, when the mature Bee rubs off the thin pupal skin which enshrouds it, the wings will expand, harden, and assume their dorsal position.

In favourable circumstances the development of a Humble-Bee, from egg to perfect insect, occupies from three to four weeks, so that about a month from the commencement of her labours the queen-mother will be surrounded by a

little band of four or five workers, each ready to bear its part in the labours of the day. As week after week passes, these workers increase in numbers. The colony begins to prosper. The queen lays more eggs. The workers go abroad and return laden with pollen and honey. Yet a colony of Humble-Bees is never very numerous, even in the height of its prosperity. In the case of a subterranean species, the nest may contain from 300 to 400 individuals—an insignificant number compared with the population of a Bee hive or even of a Wasps' nest.

The social "castes" of the Humble-Bee are far more complicated than is the case among more highly civilised Bees. Normally, the inmates of a hive consist of a queen (or egg-laying female), drones and workers, or imperfectly developed females. But among Humble-Bees the fertile females, or queens, are not rigidly distinguished from the workers. The Bees which are hatched from the first-made cells consist largely, if not entirely, of the worker class. But when a colony has become established, numerous small



COMB OF COCOONS (ABOUT NATURAL SIZE).

The empty cocoons from which young Bees have emerged are used as honey pots. The snail shell was built casually into the nest.

queens are often produced; and these supplement the efforts of the original queen in egg-laying—as, indeed, do certain of the workers on occasion. Again, the workers vary much in size, and it seems that their avocation is bound up with their muscular proportions. For observation seems to show that while the larger workers go much abroad in search of food and nest-building materials, their smaller sisters scarcely ever leave the nest, where they pass their time in feeding and otherwise caring for the grubs. In a word, the population of a Humble-Bee's nest in the height of summer consists of individuals of many sizes, whose callings and occupations differ widely. At the approach of autumn, a brood of drones, or males, is produced, as well as a number of large queens—the latter being destined to survive the winter and perpetuate the species during the succeeding year.

The cheery, easy-going nature of the Humble-Bee is reflected in the fact that the honey tubs are never sealed up, but are free for all who hunger to take their fill. In good weather a prosperous colony will amass much honey. This, as we have already seen, is stored for the most part in the empty cocoons, some of which are built up or altered for the purpose. But the Bees also make additional honey pots of the pseudo-wax (formed from an agglutination of vegetable matter) which they are able to produce. This substance is not wax such as the hive Bees make. It is not plastic to the fingers; while it burns,

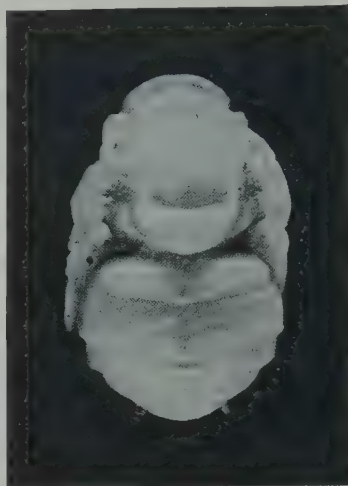
leaving a carbonaceous residuum which readily attracts moisture.

In the limits of a short article it would be impossible to enumerate all the points of interest connected with the life story of the Humble-Bee. But one or two

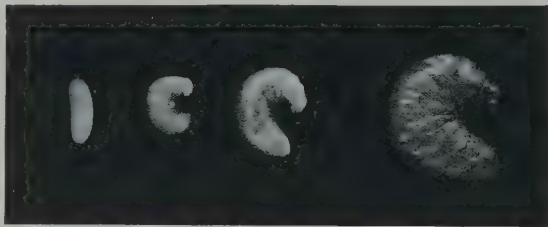
additional facts may be recorded which seem calculated to inspire in the reader a desire to investigate more fully the habits of these interesting insects. The "tongue" of the Humble-Bee is of very great length, and because of this the insects are of importance to agriculturists, as they are able to probe the depths of certain flowers from which short-tongued insects (such as the Honey Bee) cannot suck the nectar. For instance, Humble-Bees alone visit red clover and effect its fertilisa-

tion. It has been suggested that certain moths may also fertilise red clover flowers; but Darwin, who devoted much time to the study of this question, expressed the opinion that it

seemed doubtful whether the weight of the moth would prove sufficient to depress the wing-petals of the flowers. He added: "We may infer as highly probable that, if the whole genus of Humble-Bees became extinct or even rare in England, the heartsease (another flower favoured by Humble-Bees) and the red clover would become very rare or would wholly disappear." Strangely enough, this speculation has been shown to be something more than a mere scientific pleasantry. In New Zealand, when first the red clover was introduced, it was found impossible to fertilise



HUMBLE-BEE PUPA—UPPER SIDE
(MAGNIFIED).



THE EGG AND EARLY DEVELOPMENT OF THE
HUMBLE-BEE (MAGNIFIED).

it. Living Humble-Bees were actually imported into the country, where they have now established themselves, with the result that the cross-fertilisation, and consequent seed-setting, of the clover is duly accomplished.

In conclusion, a few words may be added as to the best means of studying Humble-Bees. The reader (for his own comfort) may bear in mind the fact that, although Humble-Bees possess stings, they are by no means aggressive in the use of these weapons. Thus, the taking of a Humble-Bees' nest need not be regarded as a formidable matter. First mark down your nest during the hours of daylight. If you see a succession of Humble-Bees entering or leaving a hole in a bank, you may be assured that this hole is the entrance to their home. Humble-Bees usually cease work a short time before sundown; so that if you return to the spot just before dusk, you may be sure that most of the Bees will have entered the nest for the night. Bring with you a good-sized cigar box, a bottle of chloroform, a pair of forceps, and a gauze-covered, wide-mouthed bottle. You will also need a trowel to lay bare the nest.

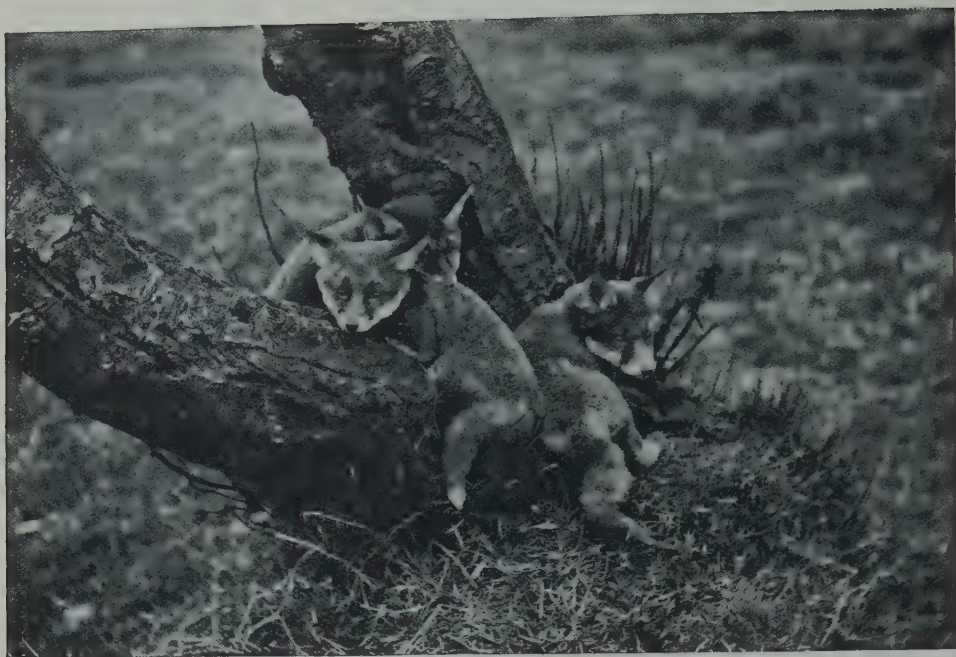
As soon as possible, pour a little chloroform over the nest, and wait until the humming has ceased. Then push aside the mass of vegetable refuse which covers the comb and gently pick up the stupefied Bees with the forceps, putting them into the bottle. The nest should then be carefully raised and placed in the cigar box. Now put the Bees also into the box, where—if the chloroform has been used with reasonable moderation—they will soon revive.

Before taking the nest, a sheet of glass should be substituted for the lid of the cigar box, while a hole about one inch in diameter should be made in one end through which the Bees may come and go. It is a good plan, however, to stop up this hole for twelve hours or so after the Bees have been placed in the box, in order that they may become accustomed to their new home. Thereafter, the box may be fitted below a window-sash so that the Bees pass in and out without annoying the observer, who remains in the room. In this way an interesting object lesson is provided, the fascination of which will continue throughout the whole summer.



THE THREE KINDS OF INMATES OF A HUMBLE-BEES' NEST.

Left: A typical "worker." Centre: The "queen," or chief egg-laying female.
Right: A "drone," or male.



THE AGE OF INNOCENCE: FOX CUBS AT PLAY.

WOODLAND STORIES

A Dialogue between a Cuckoo, a Fox, and a Rabbit

By S. L. BENSUSAN

With Photographs by C. Reid. Wishaw

HAD you been in the Heron Wood just then you might have seen a bird no bigger than a fieldfare winging a curious hawk-like flight from the lone elm in the lane. He passed high over the beech trees that edged the cover, swept down over the riot of alder and briar, and lighted at last on the pink thorn by the side of a patch of clear green sward. There he swayed on the branch he had chosen and listened for a moment. High above him the lark's song fell in a shower of golden notes, in the heart of the greenery a thrush sang to his mate. The bees contributed their quiet undersong to the harmonies above and around them, the spirit of April was brooding

over the land. "Cuckoo!" cried the stranger gladly, "cuckoo!"

From a hole in the sandy patch of ground that passed between the green sward and the bushes a sharp little face peeped out, as though in answer to the call, and a small fox cub, owner of staring eyes that had not been open very long, came into the open and sat down on his haunches. He was followed slowly by three sisters, his equals in size but not in confidence. They remained close to their earth, standing on all fours with heads down, and looked for all the world like balls of yellow-red fluff.

"Now I have an audience," said the Cuckoo, who was well pleased with

himself, and he called again, several times.

The grass snake that had been sunning himself on the bank was not quite sure that the cry boded him any good; his family had been persecuted for generations, and he felt it was impossible to remain where he was with any sense of security. So he glided away through the grass and was lost to sight. But Mrs. Doe, the wife of a Buck Rabbit who lived in the warren, came out of her stop a few yards away from the Foxes' earth, and her eight little ones followed. The wild parsley was still within reach of their teeth, and they had recently learned to use them. So they started to nibble the green stuff, keeping close to Mrs. Doe the while.

"Cuckoo!" repeated the bird in the pink thorn. "How are you all? I've come a long way over the sea to visit you."

"Did you see any men or dogs about, sir?" said Mrs. Doe, anxiously. "I've a young family, and I know what trouble is. One can't be too careful here."

"The men are working in the big field behind the brook," said the Cuckoo;

"I saw them as I passed, but they did not look up, they were too busy hoeing. There are no dogs nearer than the farmyard, and they are on the chain."

"Thank you, sir," said Mrs. Doe; and then turning to her children she added, "If I stamp my hind legs on the ground, run back to the stop as quickly as you can; don't stay to ask questions or to look about you."

"What is trouble?" said the young Fox, "and where does it come from, and what does it look like?"

"Where are your parents?" said Mrs. Doe anxiously, as though ignoring his question.

"Down in the earth behind me," said the Fox Cub. "Father brought home a nice big chicken, and mother brought some rats for us, so we all had a good meal, and now father is fast asleep. Mother is watching by his side, but she said she wouldn't come out much before sundown because she is so tired."

"They know what trouble is," said Mrs. Rabbit, "and you will learn all about it some day. Wait till you are just a little older."

"This isn't the time for trouble,"



A LITTER OF FOX CUBS.

cried the Cuckoo, swaying on his bough ; "the birds are building, and the sun is shining, and the flowers are covering the meadows. When I come from over sea there is no trouble in the countryside. April is here ; she and I are old friends."

The Rabbit thought of the chicken and the rats that had provided the Fox family with an early breakfast, but said nothing. Perhaps she felt the intoxication of her first spring—she was not yet a year old.

"Why aren't you in the warren under the bank ?" asked the Cuckoo in a lower voice. "If you're afraid of trouble, why do you bring your family next door to a Fox earth ?"

"We does must go from the warren when a family is coming," explained Mrs. Rabbit. "If we stayed there our young would be trampled on, and we should never be allowed to look after them in peace. Big buck rabbits are so careless and so thoughtless. So we leave the family house and make a stop not far away. When the youngsters are able to look after themselves we shall all go back, unless we take a great liking to this spot. If we do, the children and I will burrow fresh holes. The land here is rather light, though there is heavy clay outside the cover. I scraped out my stop in a day and a night."

"It's odd that you should go away in that fashion to bear and rear your young, for that is just what the great big animals of my winter home do," said the Cuckoo. "The giraffe and the elephant and some of the deer follow the same practice. But what about the foxes next door to you ?"

"They leave rabbits alone now," explained Mrs. Rabbit, lowering her voice in her turn. "I was born here, and brought up with them, when I was no bigger than my babies. There has always been a Fox earth here. I think it's all right, and that we are safe—as safe as any rabbit can be."

The baby Rabbits had gathered courage, they had eaten all they wanted, and were attracted by the Fox Cub's fluffy little sisters, to whom they ambled rather clumsily. The Fox Cub ignored the intruders. He felt too grown up to interest himself in their gambols. And he wanted to know all about the world—

the spirit of curiosity had come to him at birth.

"Have you been right across the field ?" he asked the Cuckoo.

"I have taken many a long day's journey over land and sea," replied the Cuckoo proudly ; "from forests I could not fly across in a morning, and strange sunny lands where men are black, and white folk are seldom seen."

The Fox Cub was silent and a little confused. He knew nothing about seas or men, white or black, but did not care to say so. So he snapped at a busy fly that would buzz round his nose, and then scratched his ear with his paw. He hoped to go out with his father soon and see the world for himself. Already he found it dull to stay in through the night while his father was away hunting, but his mother would not let him leave her side.

"Hush !" cried the Cuckoo suddenly, "some one is coming." He slipped back amid the foliage. The mother Rabbit stamped her hind legs, the little Rabbits scampered back, their parent followed them to the edge of the stop where she crouched, but the Fox Cub and his sisters did not move. They had yet to learn the meaning of fear. The greenery was parted at the far end of the sward, and a keen-eyed horseman looked across the clearing. His face brightened as he saw the cubs ; he counted them twice, stared round the cover very carefully, and then, quietly turning his horse round, rode away. A moment later the Cuckoo emerged from cover and Mrs. Doe from her stop. "What was it ?" she asked nervously, keeping an anxious touch upon the little ones who clustered round her white tail.

"It was something very big," explained the Fox Cub calmly, "bigger than the bush, and it moved. But when I showed my teeth it turned round and went away." He felt greatly encouraged by the incident. Clearly he was a person of importance, and inspired fear in things much larger than himself.

"If it has gone," said Mrs. Rabbit, "we are quite safe, and I'm very hungry." She moved forward into the long grass that nearly covered her little ones, but her white tail stood up like a flag above the rising growth, and they followed that.



"NATURE RED IN TOOTH AND CLAW."

The Fox Cub's sisters ventured a little way from the mouth of the earth; between them and the Baby Rabbits there was an attraction that neither could resist for long. They sidled up to one another gradually, sniffed curiously at each other's fur, and were soon playing merrily, just as though they had been kittens.

On a sudden the Vixen showed her cunning head at the mouth of the earth, Mother Rabbit drummed with her hind legs on the ground, and six of the little rabbits ran helter-skelter to cover. The other two crouched low for a few seconds, and only raced to the stop when the path was clear of their brothers and sisters. Their mother crouched by the edge of their home. Apparently there was no occasion for uneasiness. The old Vixen smiled from ear to ear. "Pretty dears," she said; "enjoying a romp with my little ones, too. And not half-grown up yet, the darlings," she added, licking her lips. So saying, she slunk away into cover in the direction of an outlying farm that was full of rats. She had been there once or twice every day since her litter had learned to eat flesh.

"Cuckoo!" cried the bird in the pink

thorn, "how nicely she talks, to be sure! I wonder what mischief she is after now. She would not have moved off so contentedly had she known that anybody had seen her cubs."

A splendid dragon-fly hovered on shimmering wings over the Fox Cub, and he tried hard to catch it. Presently it darted away to the far end of the grass, and he ambled after it. His three sisters followed him, and the Baby Rabbits joined them. Then the dragon-fly rose high into the air and passed out of sight, and all the little Fox Cubs sat up on their haunches and strained their eyes into the blue above them. They were very sorry to lose a new playmate.

"Have you a deep hole down there?" said the Cuckoo to Mrs. Rabbit.

"It's a four-foot slope with a turn up into the bed-sitting-room," she replied; "and I've lined it with my own fur until it is as warm and comfortable as one could wish a home to be. I had my family down there nearly a fortnight before they could lift their ears or open their eyes. It was a great joy to find them learning to feed themselves."

"Dig on, dig down!" sang the Cuckoo,

swaying his body to and fro. "I'm an old bird, twice as old as you are. I know the world, and you don't. Dig down, dig on, dig deep," and with these words of warning he flew away, to be mobbed by a company of finches as soon as he reached the open, because they thought he was a hawk.

Mrs. Rabbit sat for a moment thinking as deeply as a rabbit can. She was trying to guess what the Cuckoo meant, but soon gave up the effort, for she saw some delicate grasses a few yards away. She ran forward with a strange haste and fed heartily, looking round now and again to where Cubs and Baby Rabbits were still playing lazily or basking on the green sward. Then her quick ear caught the sound of a cracking twig; she called her little ones to her side and ran for home just as the Vixen returned carrying two dead rats in her mouth. The Fox Cubs ran to their mother, who watched them fight over the dainties and tear them to pieces, but it was a sight that could only have pleased a fox. Mother Rabbit did not like it at all, there was a certain ugly significance about the action that frightened her. She kept her little ones

from all view of the proceedings, and, as they would persist in scrambling to the mouth of the stop, she turned round and pushed them before her to the warm chamber beyond the sloping passage. Once in the shelter of her warm fur they soon fell asleep.

Night came slowly to the countryside, driving the light before her from the Heron Wood. The nightingale's song was very clear now, so, too, was the wood lark's, and from time to time the black-bird, whose nest was in the holly bush, would pipe a note or two, to show that his voice was in good order. Moon and stars shone bright above the Heron Wood in a steel-blue sky, and the Cuckoo, coming back to the pink thorn that the dew had made more fragrant than before, lent his merry notes to the support of the invisible choir.

"It's time to be up and doing, my dear," said the old dog Fox to his Vixen as he stretched himself; "the youngsters are all asleep. I think I'll work the home farm; there's a lot of young poultry about just now."

"There are some ducks round the pond at Maylands," said the Vixen. "I'll



A TERRIER FOSTER MOTHER.

go there, and if I can't reach them I'll hunt the gorse by Meadowbank for rabbits."

"Why not take the family of rabbits only a few yards away if you don't want to go far?" suggested the dog Fox. "The stop can't be very deep; you could dig it out in an hour and kill the lot."

"Just so," replied the M.F.H. carelessly, as if he had his doubts but did not care to argue the point. "Where did you say you saw that litter of cubs?"

"On the edge of the clearing in the Heron Wood," said the Squire. "The old ones weren't about, so there's no



A YOUNG RABBIT HIDING.

Photograph by E. Hanley.

"Not yet, dear," said the Vixen, licking her lips. "I've counted them—eight and the mother. They won't be grown sufficiently for another three or four weeks, and it's well to have some reserve food near home in case of trouble. Let them play with the children until they are bigger," and she licked her lips again, as she followed her lord and master over the dew-drenched grass.

On the verandah at the Hall, the Squire sat with his friend the M.F.H. They were smoking and listening to the nightingale.

"How peaceful everything is!" said the Squire. "There's nothing better than a late April night in England."

danger of the vixen shifting them, and I've given strict orders that nobody is to go near the place. When cub hunting starts we ought to have a certain find there."

"Yes," said the M.F.H. "They always like that bit of light land. Four, you said? That will blood hounds nicely. Hark, do you hear that call?"

In the distance the dog fox was calling lovingly to his mate across the deserted fields. "There's an old one," remarked the M.F.H., as he flicked the ash of his cigar over the verandah. "How early the violets spoilt the scent this year," he added after a pause. "And how far away November seems just now!"

S. L. BENSUSAN.



THE LAPWING, OR GREEN PLOVER

By BENJAMIN HANLEY

With a Photograph by the Author

WHEN male blackbirds loudly challenge each other over their choice of a mate, and rooks caw noisily about their nest-repairing, the love-notes of the Lapwings are heard echoing over the fallows, and the birds begin to separate from the flocks in which they have passed the winter to take themselves off in pairs to choose a suitable nesting site. In this selecting they appear to be in no hurry, for one might watch them standing motionless for minutes at a time, seemingly well content to be simply together. When, however, they do decide upon a likely situation, such as a slight natural depression in the soil or a hole made by the hoof of some animal, the actual nest-building takes up little or no time—a few straws and grasses merely being brought together; often, indeed, even these are omitted, and the eggs laid on the bare ground.

Four in number, the eggs are pear-shaped, olive green with blackish-brown blotches. On some occasions there are only three in a clutch, but this is not usual. The young, when hatched, are bonny little things, clad in a black and buff coloured down. They are able to run and feed themselves almost directly, looking like nothing so much as a bundle of fluff on two stilts.

As summer merges into autumn, both old and young gather into flocks, and,

later still, their numbers are considerably augmented by immigration from the Continent, until the flocks begin to assume gigantic proportions. In some districts, during the winter months, it is a daily occurrence to see flocks composed of between five and six thousand birds. They are hardly ever still, running up and down the furrows in search of food.



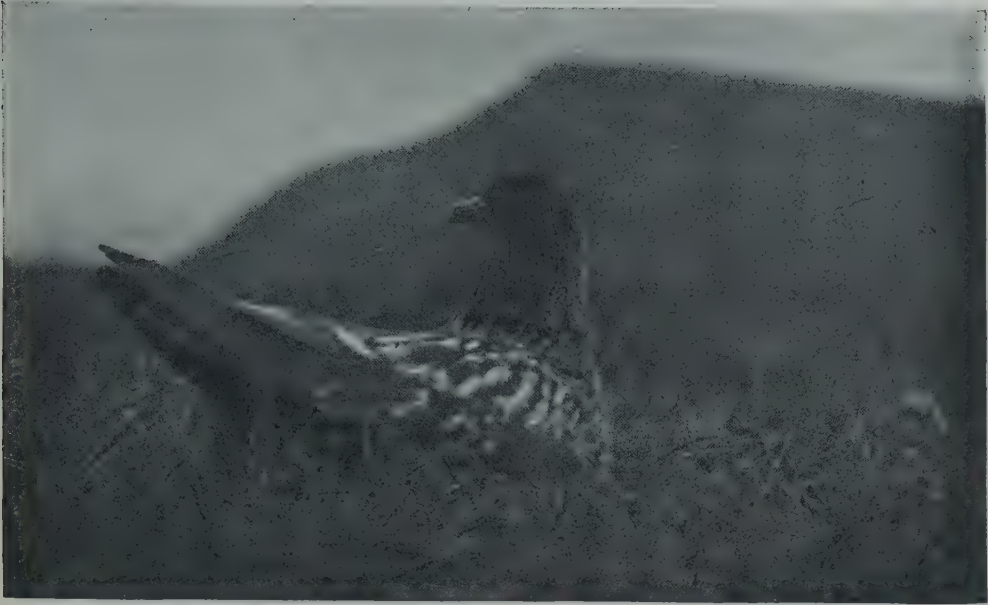
THE LAPWING.

Seen from a distance they appear black and white, but when viewed at close quarters it will be seen that above they are metallic green with purple reflections; crown and crest blackish green, throat and upper breast bluish black, under tail coverts tawny. In summer the face is blackish and white, but in winter it presents a mottled appearance. This is more pronounced in the case of birds of the year.



IN THE WOOD.

From the Painting by E. G. Warren in the Victoria and Albert Museum.



THE GREAT SKUA BROODING.

THE KING OF THE GULLS

"The kingdom of Sea-fowl which the Skua rules with tyrannical might"

By A. J. R. ROBERTS, B.A.

Illustrated with Photographs by the Author

A HEAVING expanse of ocean, calm as the Atlantic can ever be, mirrored a cloudless June sky and glittered in the merciless sunlight. Here and there a flock of gulls rested on the water, preening their gleaming white and pearly grey plumage; a few, still hungry, quartered the ocean on effortless wings like sleuth-hounds in their search for prey. Presently one bird plunges headlong to the sea. There is a splash, a silvery gleam, and in a few seconds the bird flaps somewhat heavily up from the water—to poise and plunge again. Like vultures watching each other, the gulls collect from every quarter. Bird after bird rises from the scattered flocks which melt like patches of snow in the noon-day sun—only to re-unite in one whirl-

ing snowstorm of birds, hovering, rising and falling over a shoal of fish that has come to the surface. Suddenly from nowhere a dark form appears, gull-like, yet not a gull, a very hawk among gulls. Choosing his victim from afar, the Great Skua steels his wings and devours the space that divides him from his prey. An ominous swish of wings passing close overhead is the summons to deliver the prize; then soaring in one sweep the Skua checks his headlong rush and prepares to receive his tribute. In vain his victim gulps down his catch and tries escape—the winged fury is on him. Dodge, double and swerve as he will, he cannot shake off his pursuer. Once more the relentless rush, but this time the taloned feet are lowered to strike. One blow is enough;

the gull pauses an instant in its flight, and the disgorged fish falls shimmering to the sea. Swift as a hawk the Skua stoops with half-closed wings, overtakes and seizes his ill-gotten meal before it reaches the water, then with leisurely flight he wings his way back to the island mountain, looming purple on the horizon.

A "sixern" boat, a veritable model of the old Viking ships, manned by a blue-

the spot where, more than a thousand feet above the sea, the Great Skua has made its home.

Imagine an island, roughly pear-shaped, some three miles long and rather more than two wide, which boasts three mountain peaks all more than 1,200 feet high, yet rising so abruptly that their base is not co-extensive with the coast. Along the eastern side there is a strip of com-

paratively flat, low-lying land, gradually increasing in width till it includes the whole southern tail with the exception of the Noup, a sugar-loaf hill 800 feet high. Approaching the west coast from the north the cliffs rise rapidly, till they form one mighty rampart where for a mile there is scarcely a point less than 700 feet high, the whole culminating in the Kame, the highest cliff in Great Britain, which falls sheer, with but one slight break, more than 1,200 feet into the Atlantic. People the whole with vast colonies of kittiwakes and armies of guillemots, cover the



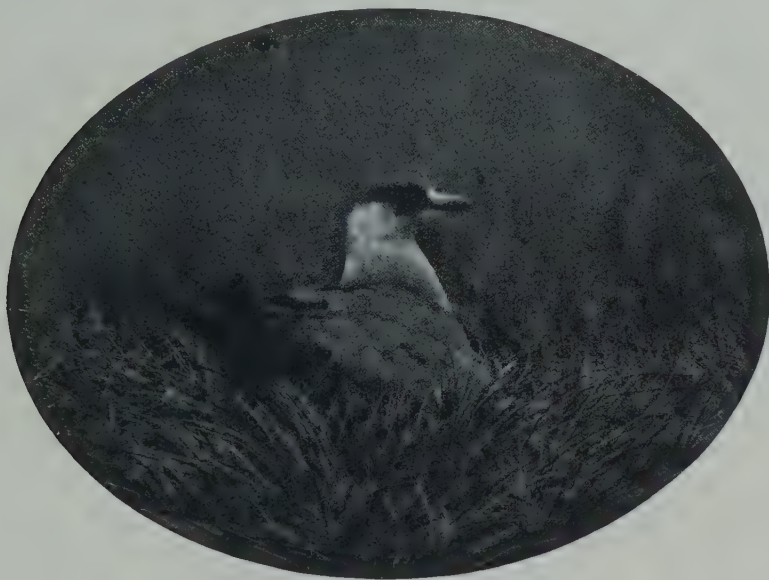
AN EXTRAORDINARY CLUTCH OF RICHARDSON'S SKUA'S EGGS—
TWO IS THE USUAL NUMBER.

eyed, fair-haired crew, whose names bespeak their Norse origin, is the sole connecting link between the island of Foula and the mainland of Shetland and civilisation. Weekly in summer, and fortnightly in winter, weather permitting, it crosses the fourteen miles of perilous tide-race to the township of Walls, carrying the mails and fetching a slender supply of provisions or an occasional passenger. The seas run mountains high whenever the breeze backs against the tide, but fortunately the seamanship of the old Vikings has descended with their blood, and the boat rides lightly as a gull. On opening Vaila Sound Foula comes into view, purple with distance, its fantastic contour cleaving the sky as with mammoth teeth, or else wreathed in cloud as though to hide

slopes with puffins and razorbills, distinguish the fulmar amidst the flocks of herring and lesser black-backed gulls by its indescribably graceful flight, search the lower benches for colonies of cormorants and the caves for the shag, and then perhaps you have some slight idea of the kingdom of sea-fowl which the Skua rules with tyrannical might. Here Nature works out her own problems undisturbed, for man is powerless to interfere. On these same cliffs the peregrines rear their young on the sea-birds' flesh, and the raven has its home where no human eye has ever penetrated; but these are, as it were, accessories, accidents; it is the Skua, the buccaneer of the air, which dominates the whole and embodies the spirit of the island in his fierce, untamable character.

Ornithologically, as well as geographically, the island is divided into the lowlands, where the Richardson's Skua (or Allon, as Foula folk say) breeds, and the hills, where the Great Skua (or Bonxie) reigns supreme. The territory occupied by the two species has, of course, no definite boundary, but there is a wide belt—a sort of no man's land—dividing the two. Well were it for the Allon if it

motherly instinct triumphed and they crouched in an endeavour to shield their young; but most were left to seek shelter as best they might, for in the warring of the elements it was each for himself. Here and there I found hollows which had been nests and now were pools in whose midst the eggs rose as twin islets. In one case the egg-shell was broken and the beak of a young bird



RICHARDSON'S SKUA SITTING.

did occupy the lower parts of the hills, for on the level ground it is too much at the mercy of the storm. My first day on Foula gave me an insight into the constant struggle against the varied forces of Nature which is the life of all wild creatures. No quarter is asked for, none can be given. Might is right, and sooner or later all fall in the fighting line; for there is no gradual decline and peaceful death for any other than man. A gale hitherto unchecked in its course over the Atlantic was wreaking its fury on the island. The wind shrieked and raged over the treeless ground, and the rain descended in hissing torrents, which seared the hillsides with an infinity of tiny channels and swamped the level parts. Numbers of Allon were standing, like so many weathercocks, with their heads to the wind; in a few instances the

protruded, meeting death on the threshold of life, drowned before it really was born. Other chicks, older and stronger, had strayed away from the treacherous hollows of the nests and sought shelter from the stinging rain behind tufts of grass. For such as I found I built little shelters, but the parent birds mistook my attentions, and, rising into the storm, they swooped down upon me, striking my head with feet and wings, attacking me now from one side, now from the other so rapidly that one could not but marvel at the ease with which they set their wings like reefed sails and harnessed the very violence of the gale.

During the night the storm spent its force, and the next morning saw me on my way to make closer acquaintance with the Bonxie. The day promised fair, but just as I reached the summit of the

hills thin, filmy wreaths of vapour gathered and thickened as I watched, blotting out the world below and limiting my horizon to a circle of some thirty yards diameter. However, I went on—cautiously, for a precipice more than a thousand feet yawned not far off, and it was soon impossible to say in which direction. On all sides I could hear the subdued roar of the surf, puffs of wind drove the mist in diametrically opposite directions, and overhead from time to

dashed down from the cloud in one great sweep, and, reaching the level of my eyes, made straight at me. A powerful, hooked beak and piercing eye, a heavy body lowered to check the downward course, stiff pinions bent with the resistance of the air, clear-edged as though cut out of tin, and rattling as the air rushed through them, black taloned feet ready to strike—that is the picture of the Bonxie photographed in an instant upon the brain. Instinctively I flinched; and

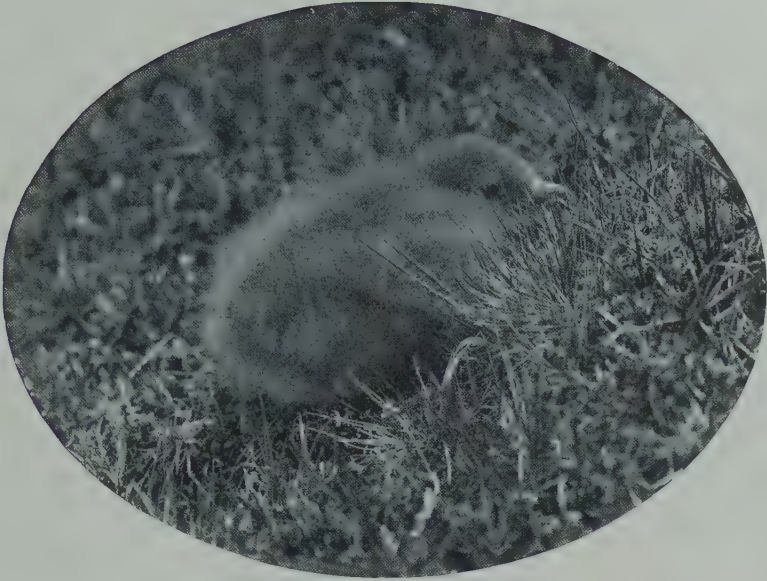


YOUNG OF GREAT SKUA AND PARTIALLY DEVoured HERRING.

time I heard the hoarse cry, "Squa, squa," from which the Skua derives its name, but as far as sight was concerned I was the only living creature on the roof of the world. The ground was covered with long, coarse grass, and presently, all unknowing, I approached the spot where a young Bonxie lay hidden. There was a roar of a body rushing through the air, a great expanse of wing brushed past my head, vanishing into the cloud, and again I was alone. Thus warned, my search became more systematic, and soon I discovered the young bird—fat, yellow and downy—crouching in the grass, and though the light was bad I attempted to take his portrait. Again the parent

the Skua, less than two yards from my face, altered the angle of its wing and skimmed over my head out of sight.

That young bird was an exceptionally bad sitter even for a young one. It bit and tore at the grass, at the tripod, or anything that presented itself. The poor light made a time exposure necessary, and all the while the parents kept up the attack, till familiarity began to breed indifference. At length I moved off, and now that my eye knew what to look for, I had little difficulty in discovering other nests, some with eggs, others with young in various stages of growth. Here and there lay the body of a puffin or the remains of a herring. One never sees



YOUNG RICHARDSON'S SKUA SHELTERING FROM THE RAIN.



A YOUNG GREAT SKUA.

the birds carrying food to their young, and it is practically certain that even the large herrings are first swallowed and then disgorged for the young ones when the nest is reached. It seems incredible that the puffin could be treated

ground within reasonable distance of the nest he has selected, he crawls along, crouching so close to the ground that the Skua's attack loses all its sting, and submitting to repeated buffeting, he philosophically consoles himself with an egg.



THE GREAT SKUA SOARING AFTER ATTACK.

in this way, yet their presence has to be accounted for. Clawed though the Skua's feet are, they are webbed and could scarcely grip their quarry as a falcon does, and I have never seen a puffin venture of its own accord inland to trespass on the Skua's domain.

The Raven alone dares to brave the Bonxie's wrath and even plunder his nest with the characteristic cunning of the crow tribe. His usual method of fighting, or rather of self-defence, consists in turning on his back in mid-air, and presenting his powerful claws, on which his enemy rushes to his own ruin. But even the Raven's confidence in his own powers melts before the Bonxie's terrifying onslaught, and he achieves by stealth what he is denied by force. Alighting on the

Wandering on, I became aware that each pair of birds had its own special portion of ground. The moment I entered upon their territory they commenced their attack, and escorted me, with their somewhat embarrassing attentions, till I reached the farther boundary, when another pair took up the task. Perhaps one had moments of resentment when the blow was especially severe, but it was easy enough to keep them at a distance by carrying a stick over the shoulder; and, after all, one could not but respect the bold defence of their offspring and pay a slight tribute to the pirate of the air, whom the Foula folk used to prize because he drove off the marauding white-tailed eagles and thus protected their lambs.

A. J. R. ROBERTS.





HORNED POPPY.

HOW TO KNOW THE SEASIDE FLOWERS—I

By the REV. H. PUREFOY FITZGERALD, F.L.S.

Illustrated with Photographs by HENRY IRVING

ONE of the attractions of the seaside, to one who is botanically inclined, is that a great many flowers may be expected which do not grow elsewhere; it is astonishing how some of them are able to grow at all, as they spring up in places where there would seem to be no soil. Some cliffs are famous for certain rare wild flowers—those in Cornwall, for instance near The Lizard, are especially noteworthy—but with these I do not intend to deal. The plants considered here may be said to be found generally round the coast, and

most of them may be expected to turn up on any ramble near the seaside.

HORNED POPPY

The most conspicuous plant that grows on the shores and cliffs around the coast is the Yellow Horned Poppy (*Glaucium luteum*), a stout growing annual belonging to the Poppy family (*Papaveraceæ*). The foliage is somewhat large, of a glaucous or pale sea-green colour; the leaves which come from the root are all stalked and divided, and somewhat rough from bearing short, thick hairs;

those leaves that grow on the stalks are much shorter, and not cut up so much into divisions, they are also smoother. The large yellow flowers (some three or four inches across), whose petals fall so soon after the flower is picked, are borne on short stalks; the petals are four in number, as in all Poppies.

The long, curved, horn-like seed pods are sure to attract the attention of any passer-by; these vary in length from six to twelve inches, and bear at the extreme end the remains of the spreading lobes of the stigma.

SEA HOLLY

The pale sea-green or glaucous bloom is more often to be seen on plants growing near the sea than on those found in more inland parts; another noticeable example being the Sea Holly (*Eryngium maritimum*). The name is given to it, not because it is any relation to the Holly, but because its leaves are very prickly, stiff and sharp pointed. On a cursory examination of the flower head it might be thought to be a member of the Com-

posite family; in reality it belongs to the same family as the Parsley and Hemlock, the *Umbelliferae*; the flowers are in a compact, globular head, measuring nearly an inch across. The lower leaves are stalked, the others clasp the stem; all of them are somewhat wavy, and they are more or less divided into three lobes at the top, and bordered by very prickly teeth, so that the plant has to be handled very warily. The heads of flowers are pale blue in colour and rest on an involucre of five or six leaves which are smaller and narrower than the rest. The flowering season is during July and August. The generic name (*Eryngium*) is derived from a Greek word signifying that the plant was at one time used as an emetic. Linnæus states that the young flower shoots are very good eating, if they are cooked in the same way as asparagus; the leaves have a sweet, aromatic taste, whilst the roots are sometimes candied, and sold as a sweetmeat. The sandy seashores of our eastern coasts are its favourite habitats; it is an attractive looking plant and one that is very easily recognised.



SEA HOLLY.



SEA ASTER.

SEA ASTER

The Sea Starwort or Aster (*Aster Tripolium*) must be sought for in salt marshes and on the shores of tidal rivers at the end of August or in September; it resembles very closely, both in shape and colour, the ordinary Michaelmas Daisy of our gardens, and it is readily seen to be one of the Composite family. It varies very much in height, generally it is about eight or ten inches high, but sometimes one comes across a plant nearly three feet in height. The leaves are somewhat thick and fleshy, quite smooth round the edges, and have three distinct nerves. The flower

heads are generally numerous, the outer florets are blue or purple; in some cases these florets are not very numerous, giving the flower rather a ragged and scanty appearance; the inner florets are yellow.

SEA CAMPION

For some time this plant was supposed to be but a variety of the Bladder Campion (*Silene inflata*); it very closely resembles it in a great many ways, but there are sufficiently distinctive features that have earned for it the right to be considered a separate species, and it is now named *Silene maritima*. The Sea Campion can be distinguished from the Bladder Campion by the leaves being very much thicker, almost fleshy, as is the case with so many seaside plants; the flowers are very large in comparison, being about an inch in diameter, and there are seldom more than three blossoms on a



SEA CAMPION.

plant ; the lobes or divisions of the petals are broad, and the whole plant is smaller and more stoutly built ; a glaucous hue may often be seen pervading the plant. The photograph will show that the Sea

Campion possesses the same inflated calyx as the Bladder Campion, this being a noticeable feature of both plants ; it is in bloom during the summer.

H. PUREFOY FITZGERALD.

SPIDERS AND THEIR SNARES

By JOHN J. WARD, F.E.S.

Author of "Life Histories of Familiar Plants," "Some Nature Biographies," etc.

Illustrated from Original Photographs by the Author

NOT all species of Spiders construct snares in which to entangle their prey. There are many kinds, such as the Wolf Spiders (*Lycosidæ*), and the familiar Zebra, or Harlequin Spider (*Salticus scenicus*), that boldly hunt for their quarry in the open. The Wolf Spiders are frequently seen low down beneath bushes (especially in woods) rapidly moving about amongst stones and fallen leaves ; they are fearless hunters, chasing their prey in a fierce and determined manner until its capture is effected. The female Spider may often be seen affectionately carrying about with her the silken sac containing her eggs, which she bravely defends when attacked. When the young are ready to appear, the egg sac is broken open and the young Spiders swarm over the back of their mother in a huddled mass, giving her a very curious appearance, and in that manner are conveyed about by her.

The Zebra Spider is familiar to most people, for on almost every sunny wall and tree-trunk it may be seen hunting its prey. The female is only about one-quarter of an inch long, and the male is less. The lateral white stripes upon the dark-coloured abdomen, and the crafty manner in which this Spider edges up to unsuspecting flies basking in the sunlight, and then, like a flash, springs upon them, readily distinguish it.

The hunting forays made by this Spider are really remarkable performances ; it

often attacks its prey on the flat bricks of an ordinary wall. It should be mentioned, however, that it takes precaution to guard against disaster. Behind it trails a silken thread, and but for this it would often fall to the ground, together with its victim, during the short struggle that ensues on the capture of its quarry ; sometimes, too, it misses its aim.

The egg sacs are not carried about by the female Zebra Spider, as in the case of the Wolf Spiders, but are hidden in crevices of the bark of trees and amongst the loose mortar in old walls. On a common brick wall, the favourite hiding-place is the narrow groove beneath the coping stones at the summit.

In the first illustration one of these Spiders prepared to exhibit its anatomy is shown enlarged ten diameters. The large and sharp poison fangs (as deadly, as far as the fly is concerned, as those of the cobra) on its head should be observed. These organs are movable, closing inwards in clasp-knife fashion, thus enabling the Spider to hold its victim in close contact with the toothed basal parts while its juices are extracted.

In warmer parts of the earth some of these hunting Spiders assume quite large dimensions. An illustration of one of these is shown at natural size on page 831. This is one of the so-called " Bird-catching Spiders " (*Theraphosidæ*), whose food really consists of beetles, resting moths, ants, smaller Spider species, etc. During day-

light these monster Spiders hide in the hollows of trees, or amongst banana, pine-apple, or palm leaves loosely spun together, emerging from their lairs at night ; while others of the family construct silk-lined tubes in the sand, closed by a circular trap-door, composed of alternate layers of silk and soil. The door fits so closely, and the simulation of the surrounding

owing, probably, to the fact that the Spider comes upon them while hunting its quarry, and their tender, featherless bodies tempt its voracious appetite. From these free-hunting Spiders we may trace a gradual evolution to those species that weave complex snares in which to entrap their prey. The first use of silk-spinning was for the building and protection of



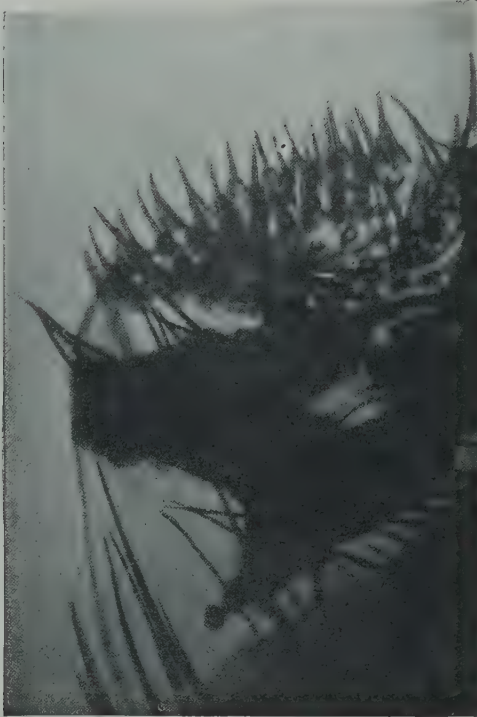
A MALE JUMPING SPIDER (*SALTICUS*), DISPLAYED TO SHOW ITS ANATOMY.

(Magnified ten diameters.)

soil is so accurate, that it becomes almost impossible to detect the entrance to the Spider's home during daylight; but at night it is more conspicuous, as the Spider leaves open the door in readiness for a hasty retreat. If attacked it bolts into its tube and clings to the silken lining on the inside of the door, holding by its legs to the sides of the tube ; in this manner it usually succeeds in defending its stronghold from dangerous intruders.

Accounts of these Spiders attacking full grown birds are largely fictitious ; young humming birds and similar small animals are sometimes attacked in their nests,

the home, and to ensure safety for the mother and young. This closing of the entrance to the tube or retreat with silk has probably led to the construction of those beautiful and geometrical snares so familiar in gardens and fields all over the world to-day. The enemies of the Spider and inquisitive insects would doubtless get entangled in the entrance web, greatly to the satisfaction of the Spider, which would thus discover a new method of capturing its prey. In due course, guided by the success achieved by this discovery, it would construct more and more complex snares outside its retreat, extending them



ONE OF THE SPINNERETS GREATLY MAGNIFIED TO REVEAL THE MINUTE TUBES FROM WHICH THE SILK IS EMITTED.

to the leaves and stems of plants and other objects; and thus by a gradual perfection of the primitive form in the course of ages may have finally evolved the marvellously constructed snares, with all their complicated details, which are so common where the Spider conducts his nefarious trade.

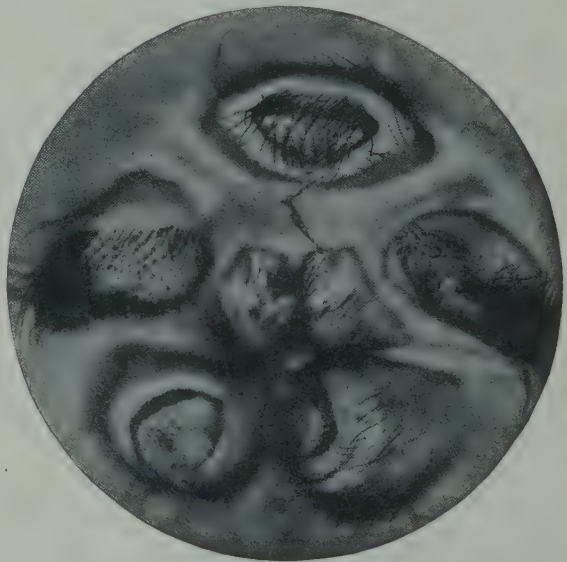
The snares of the web-weavers are the more astonishing when we consider their details. A glance at the illustration of the web of a Garden Spider (p. 829) will show that the meshes are formed by two kinds of threads. There are, first, the radiating threads, and then woven over these are numerous concentric threads. When the Spider moves about her snare it will be found that, as far as possible, she avoids the concentric threads, for these are contrived with diabolical ingenuity (I use that expression figuratively) for the capture of her victims.

The framework of the snare is composed of plain, strong strands, but the concentric threads are studded along their length with large and small viscid globules (see illustration on p. 830); indeed, the snare is not only a net in which to catch unwary flies, but a veritable bird-lime trap which hopelessly entangles them as they struggle to effect their escape.

Within the abdomen of the Spider are several powerful glands of various forms which secrete the viscid fluid from which the web is constructed. These glands are connected with the spinnerets at the hinder part of the abdomen; an enlarged view of these organs is given on this page.

As the illustration shows, there are six spinnerets in the case of the Garden Spider. Each of these organs is crowned with numerous minute tubes of great delicacy, and from these issue the silken strands. One of the spinnerets is also here shown further magnified to exhibit these tiny tubes. In the construction of a thread, the silk may be drawn from a few or from all of the tubes of a spinneret, according to the strength required.

The silk from the various glands undoubtedly differs in character. I have stated that the framework of the snare consists of plain radiating spokes or strands, and I may now add that, when formed, they harden rapidly on



A MAGNIFIED VIEW OF THE SPIDER'S SPINNERETS.



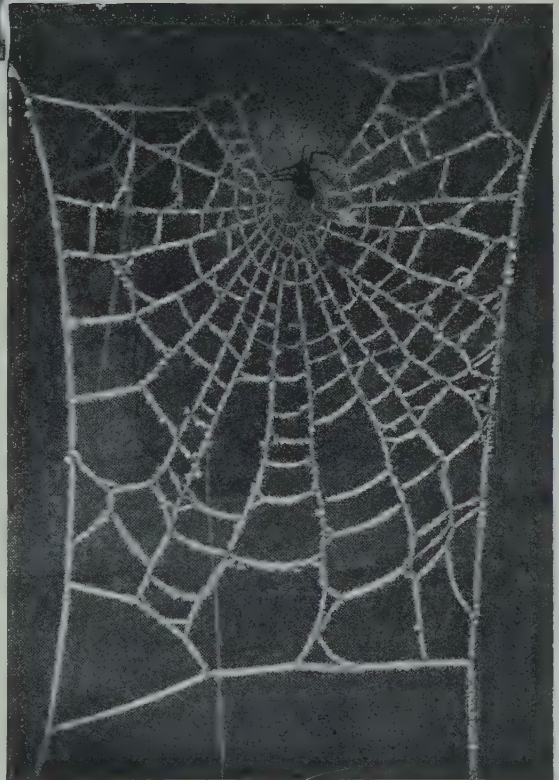
THE SNARE OF A GARDEN SPIDER.

exposure to the air. The concentric threads are also of the same plain structure when first formed, but they do not harden on contact with the atmosphere. When the thread is drawn out, the Spider gives it a sudden tug and then lets go; the vibratory action thus produced causes the formation of the tiny globules, which are generally arranged alternately large and small, as shown in the illustration on page 830; sometimes, however, they are all of one size, and at other times more or less irregular.

Although the Spider may not be seen about her snare, she is nevertheless always in prompt telegraphic communication with her complex trap. The moment an unwary fly touches one of the viscid threads, she immediately appears from beneath a leaf, or wherever she lay in

hiding, and before the fly has scarcely had time to realise its situation it finds itself confronted with a fiendlike monster glaring at it with eight bead-like eyes, while below these are a pair of toothed crushing jaws, each one terminating in a sharp and curved poison fang. A pair of large-jointed hairy organs (palpi), one on either side, add further terrors to this appalling face (see illustration, p. 830), as they wave and flourish apparently with malignant glee while the attack is made.

Then the spinnerets are directed towards the hapless victim, and a moment later it is enveloped in a shower of silken strands, spun round and round on the threads that hold it until at last it is firmly secured—still alive—in silken bonds. So the fly is



THE SPIDER'S DOOM—FROZEN AT HER POST.



1. A PORTION OF THE CONCENTRIC THREAD MAGNIFIED TO REVEAL ITS VISCID GLOBULES.



2. THE COMMON GARDEN SPIDER MAGNIFIED TO SHOW ITS ANATOMY.

left in the Spider's larder, in durance vile, until she needs a meal.

Throughout the summer and autumn months she spreads her snares for prey; occasionally her lovers, and sometimes even the husband of her choice, fall victims to her savage and voracious appetite. The winter, however, usually terminates her butchery; after a sudden and un-

expected frost her last snare may be seen conspicuously outlined in white (see illustration, p. 829). Rarely, however, is she then found at her post; more often she is hiding away, endeavouring to keep warm, in some sheltered corner; but hard days have come upon her, and Nemesis is waiting an opportunity to strike.

JOHN J. WARD.





A "BIRD-CATCHING" SPIDER FROM THE WEST INDIES.
(Photographed from life, natural size.)

THE CLEVERNESS OF THE SUNDEW

Showing the devices of a carnivorous plant to catch its prey

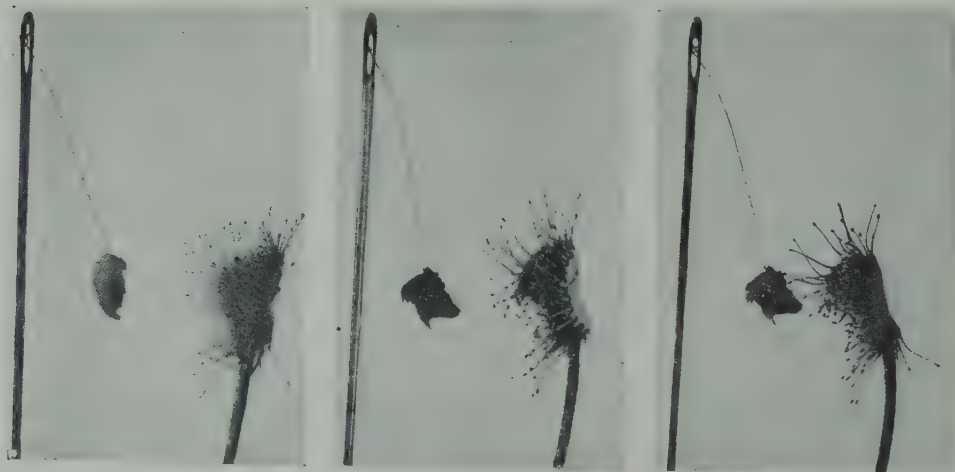
By HAROLD BASTIN

Illustrated with photographs by the Author

FEW British plants are more interesting than the Sundews—those lowly but beautiful dwellers in boggy places. Three species are recognised, to wit, the Round-leaved Sundew, the Long-leaved Sundew (both of which often grow together in profusion), and the Great Sundew, which is a more robust plant, but much rarer. The most interesting point about the Sundew is that it catches flies—as everybody knows. The leaves are densely covered with red hairs, each of which is tipped with a drop of viscid fluid. This fluid is secreted by glands that are found at the extremity of the hairs, and the most curious thing about it is the fact that it actually contains a substance which closely resembles the pepsine of an animal's stomach. When a fly, attracted by the brilliant display of the Sundew leaves, alights upon one

of them, it is at once captured and held fast as effectually as it would be had it flown against a fly-paper. If one watches a leaf which has just succeeded in catching a fly, one sees that it slowly but surely bends over and grasps its prisoner, bringing its red, hair-like tentacles into position and pouring forth a copious flow of digestive fluid from the glands at their tips. In this way the fly is speedily digested—its juices being absorbed by the plant to supply the nitrogen which, we are told, it is unable to procure in sufficient quantities from the marshy soil in which it grows; and when one fly is disposed of, the Sundew leaf casts the indigestible portions aside and resets itself in preparation for another victim.

Amazing as these facts are, they by no means exhaust the interest of the Sundew. I think it was the American



THREE PHOTOGRAPHS TAKEN AT INTERVALS OF 40 MINUTES.

A fragment of meat was suspended by a hair from a large needle, the meat hanging not far from a fully expanded Sundew leaf. The photographs show how the leaf turned towards, and eventually touched, the meat. It never succeeded in fully grasping the meat, probably because the distance was too great. But how did the leaf know that the meat was there at all?



A FLY CAUGHT BY A SUNDEW LEAF (GREATLY MAGNIFIED).

writer, Mrs. Mary Trent, who first discovered that the leaves of this plant appear to possess a sort of instinct which warns them as to the whereabouts of food. She found that a Sundew leaf would move in the direction of an insect which was placed at some distance from it. In order to verify this record, the present writer attached a minute portion of raw meat, by means of a hair, to a large-sized needle. This needle he stuck into the soil close to a young but fully developed Sundew leaf, which formed part of a healthy plant growing in a saucer. The first of the three photographs reproduced on page 832 illustrates the preliminary stage of the experiment. Subsequently, at forty-minute intervals, the other photographs were taken. These show plainly the manner in which the proximity of the meat influenced the Sundew leaf. In the second photograph of the series the leaf-stalk is bent towards the meat, and many of the red hairs are also stretching in that direction. In the third photograph the bend of the stalk

is still more marked, while several of the hairs are in actual contact with the bait. Unfortunately, the leaf had been too severely tested. It never quite succeeded in digesting the meal which it had tried so hard to win for itself. This, I think, was because the bait had been set up in such a position that actually to grasp it the leaf would have had to bend over the axis of the plant. Should the reader wish to repeat the experiment here described, he should so arrange the meat that the Sundew leaf will be able to reach it without having to bend its stalk unduly.

A healthy Sundew plant, transferred from its marshy home to a saucer, will thrive well enough provided that it is kept thoroughly moist and exposed to the sunlight. Indeed, if it is covered with a bell-glass, so that the air around it is kept saturated with moisture, the plant will rapidly send up new leaves and flower spikes. Such a "captive Sundew" will afford limitless opportunities for observation and experiment. What has already been affirmed by various

writers respecting its powers of discrimination may be put to the test. One may prove, for example, that the leaves are very partial to little morsels of steak; and that they will have nothing whatever to do with cinders, bits of moss or straw, or little pills of paper. They do not

even trouble to examine such objects with their red hairs or tentacles. The leaves seem to know instinctively whether the substance which falls upon them is good for food; and they refuse to waste time and peptic fluid on substances which possess no nutritive value.

HAROLD BASTIN.

CHAPTERS IN PLANT LIFE

I—THE ASSERTIVE PLANT

By S. LEONARD BASTIN

With Photographs by the Author

ON this crowded earth, one of the chief problems which confront the individual plant is that of finding room to grow at all. Every available space is so thickly tenanted that it is only the very sturdy, or the very ingenious, subject that can hope to hold its own in the great struggle for a position. The appearance of the June meadows is not in the least suggestive of strife, yet on every foot of the ground there has been waged a battle that has decided the fate of a countless array of units. The tall grass heads, and the graceful Moon Daisies, are but the surface representatives of a densely populated world beneath, the inhabitants of which are so closely packed together that it is pardonable to wonder how they can exist at all. Indeed, the overcrowding is such that not a trace of the brown earth is visible in the compact turf formed by the innumerable plants. It is possible to realise how keen must have been the competition for a place when we remember that for each plant which has come to perfection, several score will have gone down in the struggle.

Perhaps some of the most aggressive plants in the capturing of positions are those with subterranean stems, which run along under the soil, sending up shoots at intervals. Not a few of the grasses are marvellous instances of how

much space a single plant may cover. The maritime grass *Psamma arenaria*, so common on our coast sand-hills, spreads over a huge area of ground, as may be proved by pulling up one of the tufts. It will be found that the long stem may be traced back for several feet to the parent plant. In a very similar manner does the great Bracken Fern thrust out its rhizomes, or underground stems, in all directions, and in this way occupy the ground to the exclusion of almost everything else. In a very large number of cases, however, the stems are simply procumbent, running along on the surface of the soil. The Speedwells, the Potentillas and the Strawberries are in this way able to monopolise the situation.

In one summer a sturdy specimen will succeed in rooting its leaf joints in dozens of places; these plantlets are doubly strong in that they are not only rooted on their own account, but are still in receipt of assistance from the parent. The chances of seedlings whose lot has been cast near to one of these pushful species are doubtful in the extreme. It is a version, in the vegetable world, of the old story of the small tradesmen with single shops struggling against the great company with its hundred branches, each one of which is supported from a central establishment. Still further to the advantage of the spreading plant is the

PLANT LIFE

THE ROOT

Specimens required :—SEEDLINGS OF CRESS ; ROOTS OF CABBAGE,
COUCH GRASS, RADISH, DANDELION, AND BROAD BEAN

Structure

Examine under lens the roots of seedlings. Note the long rootlet with its small secondary roots (root hairs) and root cap. (*N.B.*—Duckweed shows the root cap clearly.) Note function of root cap. Similarly examine the fibrous roots of grass. Note in case of Couch Grass the real roots at intervals along underground stems.

Examine a Radish root, noting root hairs and fleshy storage of food at base of stem. If possible, compare this with a Radish plant that has run to seed. Note the wasted fleshy root, showing that food storage has been used up by the seeded plant.

Examine Dandelion root system, noting the long tap root. Collect other examples and examine similarly.

Functions of Root

1. One function of roots is obviously to fix the plant firmly in its situation. Note characters of roots of large plants, shrubs, and trees. Distinguish between surface feeders (*e.g.* Grass) and deep feeders (*e.g.* Currant).

2. Immerse roots of seedling of Broad Bean in solution containing red ink. Allow it to stand, and then make sections through root. Note that roots absorb dissolved food and pass it upwards to the plant.

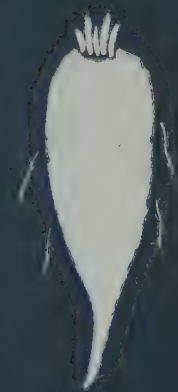
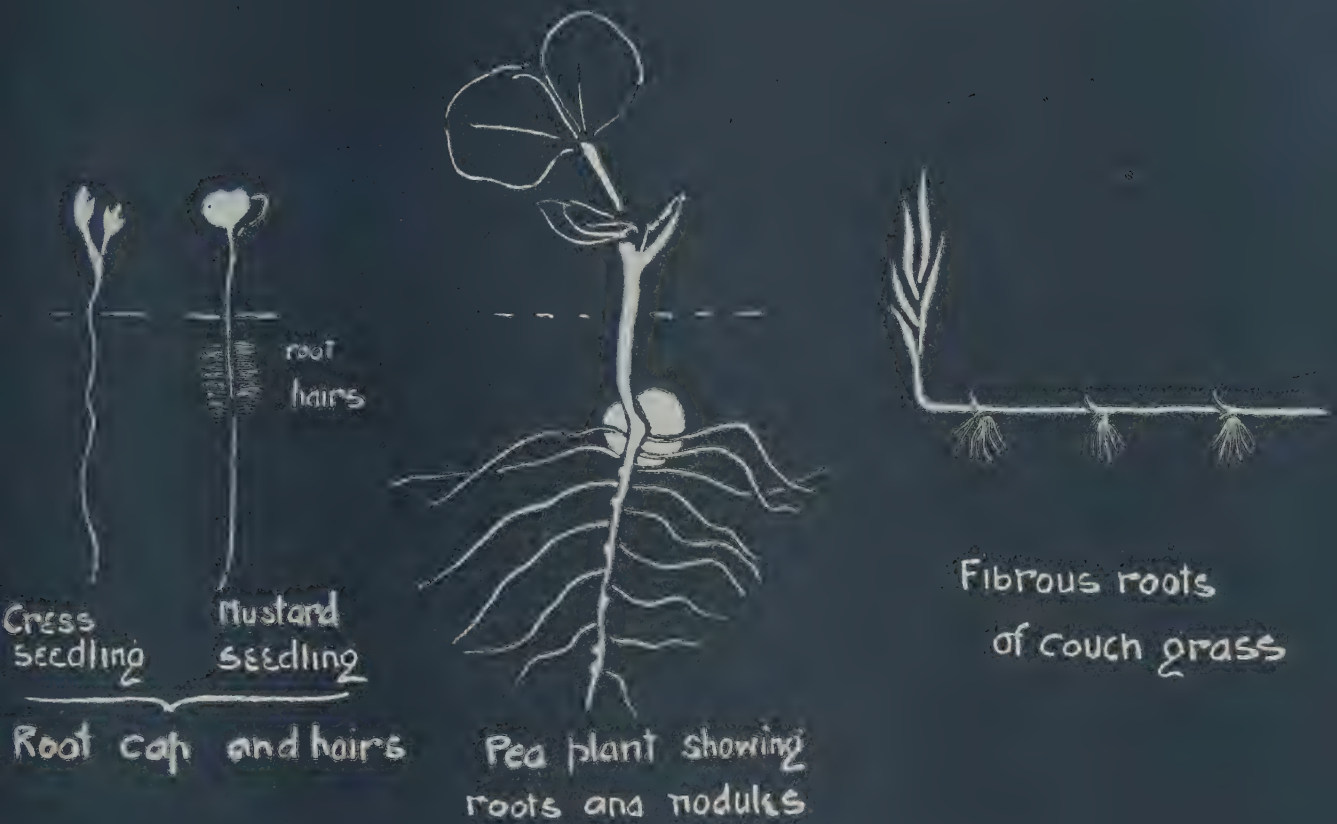
Note roots of Pea and Dwarf Bean with their nitrogen nodules ; these contain bacteria, which store nitrogenous food. Collect other examples (*e.g.* all members of Pea family).

Collect roots and classify according to characters of shape.

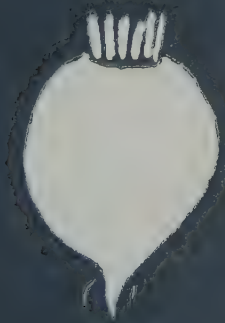
Note.—Nitrogen nodules are splendidly developed in Lupine.

PLANT LIFE

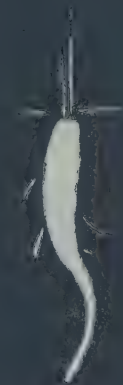
THE ROOT.



Carrot



Turnip



Wild carrot

Types of Fleshy roots

Tap root



A SPECIES OF HYACINTH WHICH DROOPS ITS LANCELIKE LEAVES OVER THE SURROUNDING SOIL AND SO DISCOURAGES OTHER PLANTS.

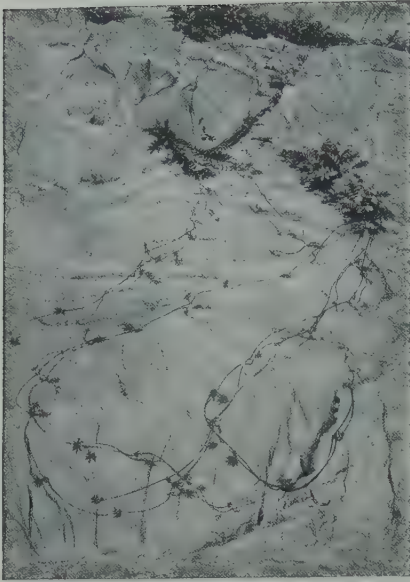
fact that if any of the sections should become detached, these enter upon the scene as new individuals, quite capable of representing the race on their own account. A large number of perennials adopt this mode of increase in addition to seed-bearing, and these are to be numbered among the most successful of plants.

There can be no doubt that the large number of species which have resorted to climbing methods have been induced to do so by the ever pressing need for room. That this enterprise has not been in vain is a commonplace fact of the countryside, for it is the Brambles, the Honey-suckles, and the Bryonies which have long since captured the hedges for their very own. Right down in the darkness at the centre of the hedge we may find the rooting-place of these plants, in situations where nothing but a subject that could grow yards up towards the light would possibly be able to exist.

The different methods adopted by the climbing plants to get up in the world

are as varied as they are ingenious. Perhaps the most common is that to be seen in the case of the twining species, which by means of their stems twist themselves round a support. Some of these plants, such as the Hop, invariably turn from left to right; whilst others, of which the Bean is a typical example, travel in an opposite direction. The constancy with which each species adheres to its particular habit of growth is very remarkable; no coercion will induce the stem to alter its natural course.

A very interesting experiment may be conducted with a common French Bean plant to illustrate the climbing methods of the species. A young seedling should be secured which has just developed its second pair of leaves. At this stage the short stem is very nearly upright, but as it develops it becomes too slender to support itself. Now comes into operation that curious tendency on the part of climbing plants called circumnutation. This consists in a ceaseless search for a support; round and round the stem



THE POTENTILLAS COVER IN A LARGE AREA BY MEANS OF THEIR CREEPING STEMS.

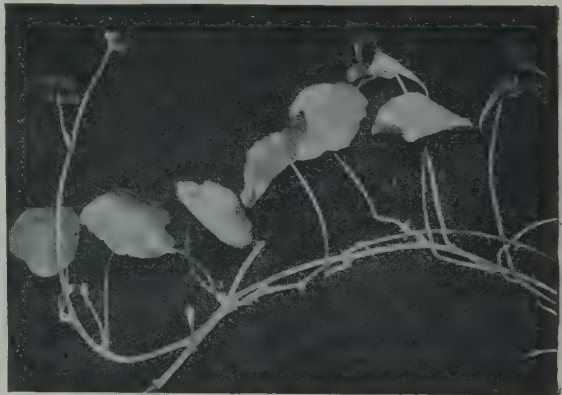
travels, reaching out farther and farther every time the circle is complete. On a warm day the stem of the Bean goes round at a wonderfully rapid rate. In one case the tip of the shoot traversed a circumference of two feet in a couple of hours, showing that the rate was an inch in five minutes—no mean performance for a plant.

When the circumnutation of the Bean has been fully observed, it is instructive to place a support within reach of the shoot. This should be upright, seeing that as a general rule the twining plants are not able to climb save up a nearly perpendicular object. The attachment to the stick is a matter which is very quickly accomplished, for a few minutes after the shoot is actually touching the tip commences to curl round. As soon as the hold is securely accomplished, the manner of growth changes into the spiral twining by means of which the stem will advance up the support. This is probably related to, if not identical with, the process of circumnutation. The passage of the bean-shoot up the support is now very rapid, and on a close

summer's night will be as much as two inches in the twelve hours.

Next in importance to the twining plants are those which clamber up by means of tendrils. These organs are among some of the most wonderful in the plant world. One interesting British plant producing tendrils is the White Bryony, a common hedgerow species. In this case the climbing organs are large, sometimes being as much as four or five inches in length. The means by which the tendrils secure a hold, and then twist themselves into the permanent position, offers a peculiarly fascinating study. Prior to their attachment to any object, the processes maintain a curious swaying movement, which must increase the probability of their coming into contact with a support. Directly the tip of the tendril is within reach of some object it begins to entwine itself without delay. In the space of a few minutes, supposing the conditions to be favourable to rapid growth, the slender thread has started to encircle the support. The underlying cause seems to be partly in the stimulating influence induced by the light rubbing of the under side of the tendril against the object. When the tendril is at its greatest period of activity it may be induced to curl round almost any object which is offered to it.

A pencil, or the little finger, passed gently along the inner side of the organ will cause it to twine around the support; the slight rubbing making the movement a good deal more rapid than is normally



THE NASTURTIUM CLIMBS BY MEANS OF ITS LEAF-STALKS.



THE HUGE LEAVES OF THE SOUTH AMERICAN GUNNERAS COVER IN A LARGE AREA.

the case. As a rule, the tendril is not content with merely looping itself once round the support, but, in order to make quite sure that there can be no slipping away, doubles or trebles the circles. When the attachment has been rendered quite secure, the strange spiral twisting comes into operation. As a rule, the turning goes on in one direction for half the length of the tendril, and in an opposite way for the remaining half.

This coiling business is very interesting to watch, and is started with the formation of a small crank-like process, which continues to make complete revolutions, swinging downwards and upwards with the greatest regularity. As it does this, the tendril is, of course, coiled on either side of the bent portion, in one direction on one side, and in an opposite direction on the other side. When the coiling is completed the small crank-like part will appear as a little straight section between the two spiral portions. At times it is to be noticed that tendrils will develop several series of spirals, and thus there may be two or three of the alternating portions. The spiral conformation,

of course, very much tends to strengthen the organ, whilst at the same time it secures to it a certain springiness that will allow a "give" when the plant strains in rough weather.

Not a few plants climb upwards by pressing into service their leaf-stalks; of these, the garden Nasturtiums and the Wild Clematis are examples. Both these species, particularly the latter, contrive to rise to a considerable height by twisting their leaf-stalks round the nearest support. The Ivy has resorted to a still more curious method, and is able to attach its stems to trunks of trees and other supports, by means of its adventitious roots which are so freely produced. These processes serve the double office of climbing organs and also as means of imbibing water; indeed, in very moist weather the ivy will often send out quantities of the white filaments on the side of the stem which is not attached to the support. Finally the common Bramble scrambles upwards by means of the bent hooks with which its stems abound. These enable the plant to catch hold of any surrounding objects,

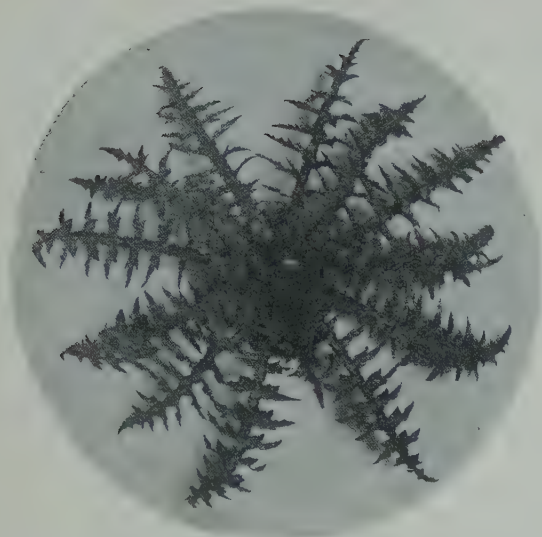
so that it easily brings its leaves into the lighter position.

It is not only as a climbing species that the Bramble is remarkable; in another way the plant offers a curious instance of resourcefulness. Every wayside patch is adorned with its Blackberry bushes, and one of the reasons for this plenitude of Brambles is to be found in a strange habit which the plant possesses. When, as is so often the case, the Bramble is growing over a pile of stones or rambling up a rough rock wall, it is seen that the plant takes root all over the place. If the lusty shoots which are sent out in such profusion come into contact with a little vegetable mould that may have collected between the chinks of two stones, or even rest for any length of time upon the ground, the points quickly lose their original character. All the features of a growing shoot vanish, and the point, becoming clubbed, eventually sends out roots. Thus a fresh hold has been secured by the aggressive Bramble.

The budding propensities of certain plants are very interesting in the part which they play in helping the species to spread over the surface of the ground. An Indian evergreen shrub belonging to the House-leek family produces leaves which at every notch in the border bear an embryo bud. The species, which is named *Bryophyllum calycinum*, can literally produce a score or more of baby plants from any of its leaves. If a leaf is thrown down on the soil the buds quickly develop into perfect little specimens. A North American fern is perhaps even more curious. This is a species of Hart's Tongue (*Scolopendrium*), and has been called the Jumping Fern, on account of its strange habit. As a rule, the buds of this species are produced at the tip of its lance-shaped fronds. These fronds, being very long and slender, trail over until their tips touch the ground, when, if the soil be in a moist condition, roots quickly form on the under surface at the point of



MANY SPECIES HAVE A HABIT OF "STARRING" OUT, AND IN THIS WAY DISCOURAGE SURROUNDING GROWTH.



THE PRETTY PATTERN FORMED BY THE DWARF
PLUME THISTLE.

contact, and from the upper surface new fronds arise.

It is certain that plants do all in their power to discourage their neighbours. The struggle for a place is so severe that it is a case of everyone looking out for himself. It is to be observed that many species have a striking tendency to cover in as much space as is possible with their leaves. Perhaps one of the chief reasons for the evolution of large foliage is that thereby the subject can more readily hold an unhampered position. In some ways big leaves carry with them great disadvantages; they are readily damaged, whilst a comparatively long while must elapse before they can be replaced. Again, the big surfaces they offer may at times bring about a more speedy evaporation of moisture than is desirable. But to balance all this, the large-leaved plants are never likely to be in difficulties for want of room, simply because their overshadowing growth will smother all the adjacent species.

Consider the position of seedlings coming up among the stems of a good-sized Dock. Completely sheltered from the light and air by the great leaves, there is not the slightest chance that they could ever come to perfection. In pulling aside the foliage of any large Dock plant we may

find the remains of the unfortunate seedlings which have perished under the sheltering leaves. The British Dock is quite a pigmy beside the great American Gunneras. These plants, which in their appearance are suggestive of vast rhubarb, produce leaves that are enormous. Borne on long, stout stems, which are at times as much as ten feet in height, the great leaves spread out in a canopy that keeps an immense area of ground in perpetual shade. The shelter which the leaves afford may be realised when it is stated that not infrequently the huge organs are six feet across.

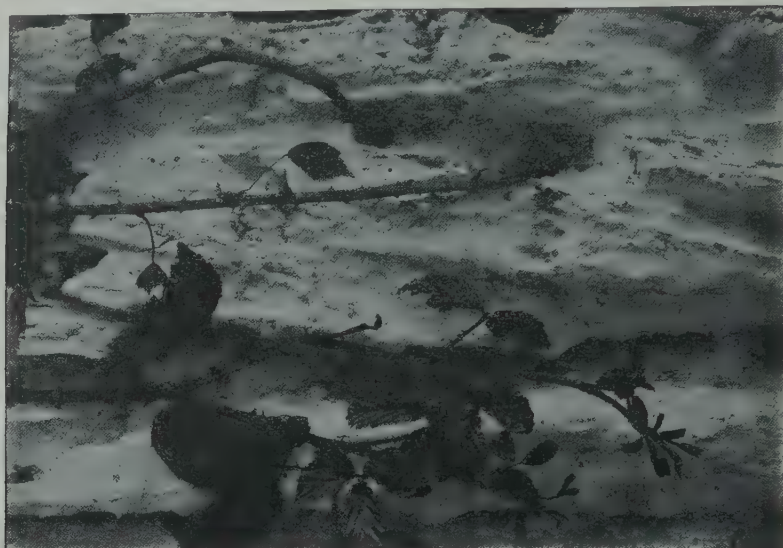
Very much the same kind of thing happens in the world of trees. When one sees the enormous crop of acorns produced by the Oak, and watches the myriads of Sycamore seeds which flutter to the ground in the early autumn, it is difficult to realise how it is that the whole country is not covered



BLACK BRYONY CLIMBING UP BRACKEN.

with these trees. A considerable number of the seeds, it is true, are destroyed by the wild animals and birds of the forest, but after all only a small number are accounted for in this way. Probably the majority of the seeds germinate, and even grow into little plants during the first few weeks of mild

rank-growing weeds which will not put in an appearance until the early summer. But as the last of the pale yellow flowers dies, the plant enters a critical period of its life; it is in grave danger of being smothered out of existence. At this time, however, a very marked change comes over the bearing of the foliage;



THE BRAMBLE IS ALWAYS ABLE TO CHANGE ITS SHOOTS INTO ROOTS SHOULD A FAVOURABLE POSITION PRESENT ITSELF.

spring weather, before the forest is clad with its summer foliage. But it is only a very few which get beyond the start, for under the dense shade thrown by the clustering leaves above no development is possible; and more often than not it is the spreading branches of the parent tree which bring about the destruction of the latter's own offspring.

Many plants which flower in the late spring might easily be smothered out of existence, had they not been enabled to make special provision against such a contingency. With the arrival of the really warm weather the countless seeds which have been lying dormant all the winter start to germinate. In this connection a curious phase in the life of the Primrose is the habit of "flopping" its foliage after blooming time. As one of the earliest of our spring flowering species, the Primrose has a good start over the

the leaves lose their more or less erect habit and "flop" over on to the ground, encircling the crown of the plant. In this way, the menacing army of seedlings which will come with the end of May are prevented from making any headway in close proximity to the plant. If it were not for this provision there can be little doubt that the Primrose would be almost choked by the rank-growing weeds which are on every side. Many of the late spring blooming varieties of the smaller Hyacinths send out a profusion of drooping leaves just at flowering time. These will make it quite certain that the plants will not be troubled by any near neighbour.

In the case of a large number of common weeds the habit of growth, which has been referred to as "starring," is a very pronounced feature. As is well known, the matter of leaf arrangement in the plant

has been devised on definite lines, and with a mathematical precision. Each leaf has its exact place, and when development is unhindered by any restraining influence the exactitude of the system becomes very apparent. In a well-developed Dandelion, where the growth is quite free, a most perfect rosette is often formed, each leaf falling into its place with a wonderful regularity. The little Shepherd's Purse, a very common cruciferous weed, which sends its clusters of dainty white blossoms up to a considerable height, employs the greater part of its foliage in covering the ground in its immediate vicinity. Examples of this plant will easily spread over a rough circle of land which is as much as nine or twelve inches in diameter. Through the dense, matted growth of leaves formed by these plants, there is little chance that any smaller species could hope to make headway.

The Dwarf Plume Thistle, a plant commonly found in meadows near the coast in the south of England, has proved itself to be a most pernicious weed from the farmer's point of view. The leaf arrangement round the central stem which bears the short-stalked flower, really forms a most attractive pattern, and one which shows plainly by what a rigid code of rules the plant is designed. From the agriculturist's outlook, however, the Dwarf Plume Thistle is anything but a welcome addition to the pasture land.

As a strong-growing perennial, when once the plant has secured a hold, its method of "starring" is very prejudicial to the growth of tender grasses and small herbs. None of these less robust plants can possibly make any headway beneath the clinging leaves of the thistle.

S. LEONARD BASTIN.



THE PRIMROSE IS IN THE HABIT OF "FLOPPING" ITS FOLIAGE AFTER BLOOMING TIME.

HOW BIRDS MAKE LOVE

Some romantic episodes in the life of a Bird

By OXLEY GRABHAM, M.A.

DURING the month of February a few early breeders amongst birds, such as the Heron and the Raven, will be taking their yearly load of domestic duties upon their shoulders. And first let me say that some birds are very matter-of-fact about it. The sexes sometimes pair off with each other with little or none of what may be called the preliminaries of love-making; whilst others, chiefly in the case of the male bird, go through all sorts of extraordinary antics, many of them decidedly grotesque, to attract the attention of the female. A third section apparently follow out the old plan prevalent among our noble selves, in olden days, of marriage by capture—and certain birds having fought a series of duels amongst themselves for the object of their affections, the conqueror quietly takes possession of his mate, whilst his defeated rivals have to sue elsewhere, and in all probability have to go through the same sort of battles over again, until in time they are all provided with a spouse.

Like the human race, again, some birds are polygamous, having many wives; whilst others are strictly limited to one, and remain perfectly faithful to her. Some species are generally believed to pair for life—and I believe that this is true. Others make a contract that lasts for one season, and after that they appear to consider themselves perfectly free to choose elsewhere; whilst others, again, either pair for two or three seasons, or else choose a fresh mate each returning spring.

It is a very curious thing that whereas amongst the *genus homo* it is the lady that is most brilliantly arrayed, enhancing her charms with jewels and raiment of many hues, amongst birds it is almost

invariably the case that the female is very plainly and soberly attired, whilst the male is often a magnificent creature, radiant with all the colours of the rainbow, and putting on for a season crests, tufts of peculiar feathers, and various other appendages, which vanish when the breeding season is over. There are exceptions to the rule that the male is the most handsomely plumaged amongst the birds of our own country—such as the Dotterel, one of the most beautiful of the Plover kind, which unfortunately is rapidly approaching extinction in Great Britain. In nearly every other instance, however, it is the male bird who is by far the handsomer; and of course a very good reason can be given for this most wise provision of Nature: namely, that it is, as a rule, the hen bird which does most of the sitting upon and hatching out the eggs, at which most important period for the life of the future family her sober, dull-coloured plumage harmonises so beautifully with her surroundings that, save to a practised eye, she is most difficult to detect.

Were the male bird to take upon himself these duties entirely—he often assists in a most praiseworthy fashion—there would be far more chance of his being discovered by marauding enemies—whether possessing two or four legs—and of being destroyed himself, along with the eggs he was incubating.

Many birds are most polite and assiduous in their attentions to their mates. A very well known instance of this may be seen any day in our farmyards—for it will there be noticed, when the poultry is fed, that the male bird will often never attempt to pick up any of the corn or dainty morsels thrown about him until he has called his hens round

him and they have satisfied themselves. Again, he will frequently, by scratching away the earth with his feet, pick out certain portions that are apt to be overlooked, and place them before the favoured members of his harem.

The antics and evolutions which are gone through by some birds in order to show themselves off, as they evidently imagine, to their fullest advantage, and to attract the notice of their consorts,

observing them, that I may be pardoned if I quote his description: "The cock bird stations himself on a pine tree and commences his love song to attract the hens about him. This is usually from the first dawn of day to sunrise, or from a little after sunset until it is quite dark. The time, however, more or less depends upon the mildness of the weather and the advanced state of the season. During his play, the neck of the Capercaillie is



THE GREAT WHITE HERON SHOWING BREEDING PLUMES.

are very amusing to watch, and are often ludicrous in the extreme. The behaviour of pigeons in this respect will be familiar to everyone. They strut about in the most absurd manner before and around the object of their affections, continually bowing down to the ground and then stretching themselves to their full height, spreading out their wings and trailing them on the ground, expanding their tails, puffing out their breasts and throats, and showing off their plumage in the bright sunshine to the best effect possible. The actions of the Capercaillie, the largest of our game birds, during the spring of the year, often when the ground is still deeply covered with snow, are well known to naturalists and sportsmen, and have been so well described by Mr. Lloyd, who spent many years in Sweden, and had ample opportunities of

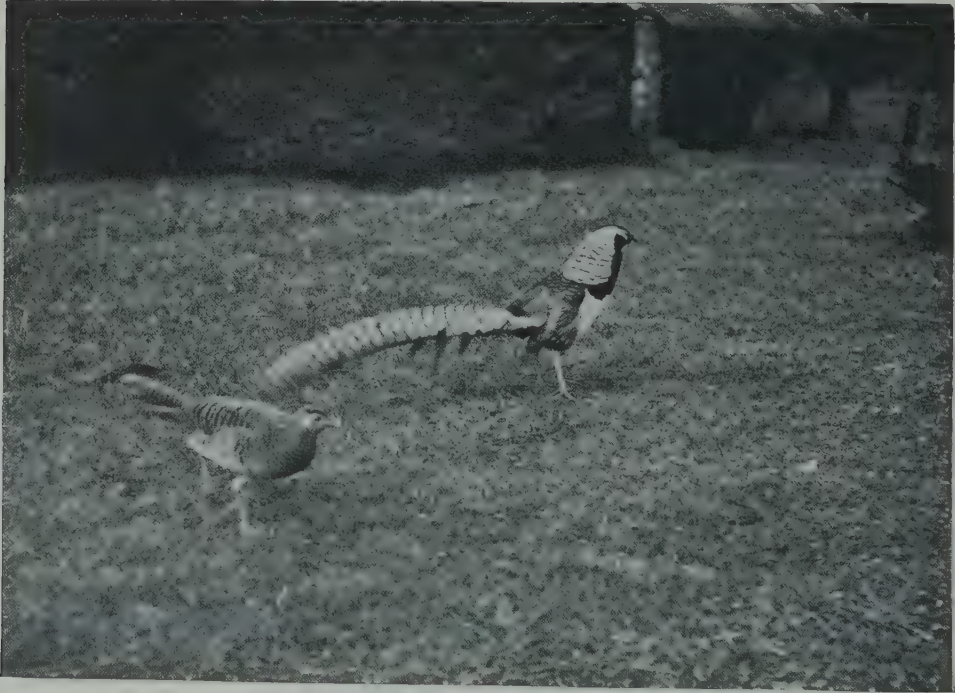
stretched out, his tail is raised and spread out like a fan, his wings droop, his feathers are ruffled up, and in short he resembles very much in appearance an angry turkey-cock. He begins his play with a call something resembling the word *peller-peller-peller*; these sounds he repeats, at first at some little intervals; but as he proceeds they increase in rapidity, until at last, and after a lapse of a minute or so, he makes a sort of gulp in his throat, and finishes by drawing in his breath. During the continuance of this latter process, which only lasts a few seconds, the head of the Capercaillie is thrown up, his eyes are partially closed, and his whole appearance would denote that he is worked up into an agony of passion. On hearing the call of the cock, the hens, whose cry in some degree resembles the croak of the Raven, assemble from all

parts of the surrounding forest. The male bird then descends from the eminence on which he was perched, to the ground, where he and his female friends join company. He does not, however, play indiscriminately over the forest, but he has his certain stations, which may be called his playing grounds. These are often of considerable extent. He does not during his play confine himself to any particular tree, and is seldom to be met with exactly on the same spot for two days in succession. On these playing grounds several Capercaillie may occasionally be heard playing at the same time. Old male birds will not permit the young ones or those of the preceding year to play. Combats, as may be supposed, not unfrequently take place on these occasions."

The Blackcock, a far more common bird in these islands than the Capercaillie, is polygamous, and has his pairing grounds, which are visited somewhat early in the season, and the *lek*, as it is called, has often been described. The males assemble even before the first dawn of day and

utter a series of notes which can be heard a considerable distance off. When the old cocks alight they begin to make love to the hens, who keep somewhat in the background amongst the bushes. They strut about with outstretched neck, trailing wings, and expanded tail, occasionally vaulting high in the air, and describing an irregular somersault, coming down with the head turned in the opposite direction. Desperate combats frequently ensue, and at times even a general *mêlée*. When the *lek* is over for the time the birds separate, each husband accompanied by the wives which he has secured.

The male Great Bustard in the breeding season throws himself into the most extraordinary attitudes, drawing in his neck, puffing out his body, expanding his tail and the pouch in his throat. He, moreover, throws his wings into the most curious positions, making them appear as if they were turned round, as it were; and upon looking at the bird when in this mood I have often been really puzzled to say exactly where the wings join the body, and where they end.



LADY AMHERST COCK PLAYING TO HEN.

To come to a more familiar bird, namely, the Snipe, everyone with the least taste for the study of birds and country sights and sounds must be familiar with what is universally known as the "drumming" of the Snipe during the breeding season. This peculiar noise made by the bird was for a long time considered to be produced by the mouth, but it has now been definitely proved that the bird, soaring to a considerable height, and then dropping

From this singular appendage the bird takes its name. The males contend for the females as in the case of other polygamous birds, and in the spring they "hill," as it is called; that is, they gather together on a bit of rising ground close to where the Reeves, as the females are called, propose to deposit their eggs. There they take their stand at a small distance from each other and contend for the females, their actions in fighting being



PHEASANTS VERSED IN THE ARTS OF COQUETRY.

suddenly with great velocity, with a tremulous movement of its wings, accompanied by the outspreading of the stiff tail feathers, produces the peculiar sound which is variously known as "drumming" or "bleating." This performance on the part of the bird is considered to be largely to attract the notice of the female, and as a kind of show-off before her. This "drumming" is continued also during the whole of the time that the female is sitting on the eggs.

Another instance may be taken in the case of the Ruff, a bird which at one time bred commonly in the Fens and other suitable localities throughout the country, but which now, save in very exceptional cases, may be considered as only a passing visitor to this country. The males have a regular thick ruff on the neck and sides of the head during the breeding season, which they can erect and frill out at will.

very similar to those of a game-cock. The head is lowered and the beak held in a horizontal direction; the ruff, and indeed every feather, more or less distended, the former sweeping the ground as a shield to defend the more tender parts; the auricles are erected, the tail is partly spread, and upon the whole the birds assume a most ferocious aspect. As in the case of many other birds that go through these duels in front of their future mates, they frequently catch hold of each other by the bill, and although they strike with their wings and legs, they seldom do one another much harm.

In the case of the smaller birds, such as the Warblers, Finches, etc., which are not polygamous but pair for one season, at any rate, and in some instances for longer, the same kind of performance is gone through.

OXLEY GRABHAM.

THE KINSHIP OF PLANTS TO ANIMALS—II

By WALTER P. WRIGHT

Illustrated with Photographs by E. J. WALLIS

IN a former article I referred to some remarkable examples of the association between plants and insects. Cross fertilisation is not facilitated by form of flower alone. Some flowers have earned an unenviable reputation on account of their evil odour. The common "Lords and Ladies" of the hedgerows (*Arum maculatum*) is one, but for the credit of the country it is satisfactory to be able to say that its smell is ambrosial compared with that of certain exotic members of the same family, notably the genus *Amorphophallus*. Perhaps the harassed reader will declare that the odour of this plant cannot be worse than its name. Possibly the effluvium disseminated by the flower attracts carrion flies and other insects that love odours generally associated with putrefaction, and which assist pollination. Certainly Nature does employ scents to attract insects, and, fortunately for us, she makes an appeal to those which like pleasant perfumes as well as to those which enjoy smells disagreeable to human noses. She caters for night insects too; note the scented white tobacco flower, and the stock. Some flowers play scurvy tricks on the insects which visit them in search of nectar, brewing so strong a liquid that it causes intoxication. Alas! observers have noted that, when an insect has recovered, it has hastened eagerly back for more, like a confirmed tippler. Lime flowers have been known to cause intoxication in innocent humble-bees, and the flowers of ivy and opium poppy have had a too potent effect on flies and other insects.

What are known as insectivorous plants have long been objects of interest. One

of the most remarkable of these is certainly the "Pitcher plant" (*Nepenthes*), a large variety of which is shown in an earlier photograph. The leaf of this plant has an extraordinary appendage, taking the form of an urn, which is sus-



Echeveria Metallica Monstrosa.

pended from the leaf by a slender stalk. The urn is partly filled with water. Insects climb over the edge, crawl down to sip, and find that they cannot get back again, because the way is barred by a row of stiff hairs which point downwards. They are drowned eventually, and provide nutriment for the plant. The urns vary in size with the variety. In some instances it is capable of holding a couple of quarts.

The *Sarracenia* is another insectivorous plant; the leaves of which resemble long tubes with open lids; the tubes act in the same way as the pitchers of the *Nepenthes*. The "Sundews" (*Droseras*) catch their prey in a different manner. The leaves are covered with a sticky substance, which captures and dissolves the insects. The "Venus's Fly-trap" (*Dionæa muscipula*) has a device for catching insects that can only be described as extraordinary. The leaves terminate in a trap, like an ordinary gin, rabbit, or rat trap. When the unsuspecting insect alights on the inside of the trap and touches the sensitive hairs the trap is sprung, and it does not open again until the insect is dead.

The curious forms that leaves sometimes take are illustrated by the photograph of *Echeveria metallica monstrosa*. A cancer-like growth appears on the surface of each leaf. It is difficult to decide what is the cause of this strange development.

The *Mesembryanthemums* (see photograph) also have remarkable leaves, which are of the thick, fleshy character peculiar to plants which are natives of hot, dry countries. Two species, called respectively *simulans* and *Bolusii*, have leaves as thick as they are broad. The leaves of other *Mesembryanthemums* are almost exactly like small pebbles.

The "Sensitive plant" (*Mimosa pudica*) has finely cut foliage which is so sensitive that it closes at the slightest touch.

In countries subjected to very heavy rains the leaves of many plants terminate in a long, narrow point, the object of which, scientists tell us, is to serve as a drain, the water always running off at the point. The gum trees of Australia (*Eucalypti*) are frequently subjected to severe storms, and consequently they have narrow leaves arranged with the edges

towards the trees so that they do not catch the wind, and the minimum amount of injury is inflicted. The wattles (*Acacias*) of Australia are curious by reason of the fact that they have flattened branches coloured and formed like leaves instead of true leaves.

Australia has given us many peculiar plants besides these. One is the "Glory Pea" (*Clanthus dampieri*), a weird and uncanny looking flower, shaped almost like a torpedo, fiery red in colour, with a black blotch, like a huge menacing eye, on a prominent boss in the centre. One may see it sometimes growing in a basket suspended from the roof of one of the glass houses in Kew Gardens. Seen just before closing time on an autumn afternoon, when the gloaming is falling, its effect is almost blood-curdling, especially if it be encountered suddenly.

The "Bottle-brushes" (*Callistemons*) are not so awe-inspiring, but are even more singular. The red flowers are arranged round the branches in exactly the form of a bottle brush. The "Flannel flower" (*Actinotus helianthi*), which also comes from the land of the wallabies, has blossoms suggestive of a piece of flannel. They bear a resemblance to the well known Swiss mountain plant edelweiss.

There is a tropical relative of the kidney bean which is called the "Snail flower" (*Phaseolus caracalla*), on account of the curious curled-up flowers resembling a snail with its house on its back.

Some flowers only commence to open when the sun sets, and fade about the time that the sun rises the following morning. Various sorts of Cacti (*Cereus*) have this peculiarity. They are dry, insignificant-looking plants during the day, which the majority of people would pass by with nothing more than a casual glance. But during the night, when in bloom, they are glorious. The flowers may be nine or ten inches across, with white, cream, or pale yellow petals flushed with red, and large tassel-like bunches of stamens. They exhale a delicious perfume.

Some flowers which are minute and insignificant in themselves have adopted an ingenious device for arresting attention, and that is to surround themselves with brightly coloured bracts or spathes. Perhaps the most remarkable example

of this is *Poinsettia pulcherrima*. The flower is absolutely commonplace, but the leaf-like bract, which is often spoken of as the flower, is large and coloured vivid scarlet. Few true flowers are so brilliant as this pseudo-blossom. The common Arum lily (*calla* or *richardia*) is a familiar example of the peculiarity now under consideration. The flower is small, but the spathe is large and pure white. The latter serves the purpose of a flower admirably, and as the plant is "in bloom" during the winter and spring it is found extremely useful by gardeners, and by those who decorate rooms and churches.

The warm house plant called the "Flamingo flower" (*Anthurium*) has large orange or scarlet spathes, and the greenhouse wall plant *Bougainvillea glabra* has bracts of a lovely satiny mauve hue which are produced in such dense masses as to hide the leaves.

One other example may be given, and that is "the largest flower in the world"—*Amorphophallus titanum*. The true flowers are arranged on a spadix five feet high. The spathe is from three to four feet across. Only one leaf is produced, and that may be twelve feet high and fifteen feet across.

Nature, then, has many plant wonders, but her "Century plant," which blooms regularly every hundred years, is a myth. The reference is to *Agave americana*, but the truth about it is that it dies after flowering. Its peculiarity of only blooming once is shared by some of the hardy bamboos. There has been quite an epidemic among these plants of recent years, which have been dying off in various parts of the country, but it is not a case of disease. The plants have arrived at their flowering stage, and their life work is ended.

WALTER P. WRIGHT.



MESEMBRYANTHEMUM TRUNCATELLUM.



THE ROSE GARDEN, HATFIELD HOUSE.
From the Water-Colour Drawing by E. A. Rowe.



YOUNG HOUSE MARTINS.

NESTLINGS

By J. WILLIAMSON

Illustrated from Open-air Photographs by the Author

OFTTIMES during the long winter evenings have I taken up my photographs of bird life and gone over the old excursions. These are pictures of which one never tires, they are redolent of white and sparkling sunshine and growing woods and singing birds.

The empty woods in winter make the heart heavy with the thought of past joys, and one is inclined to make odious comparisons. I think of a deserted ball-room, now dark and cold and empty, where once fair women and lights and sparkle of conversation illumined the scene. The trees in the wood are bare and uninviting, there is no luscious thicknesses of undergrowth with mosaic of colouring, no scented and warm air nor the musical sounds of yore, and—most unkindest cut of all—no merry

voices of bird and bee nor sound of growing things. The glorious pulsating heart is verily asleep. But now it awakes and the singing of birds is come. They are singing love songs to their mates, and after a while there is ushered into the world the sweetest thing in Nature—nestlings, downy little dears that appeal instinctively to the human heart. When a woman discovers a nest full of young birds she just wants to hug the lot. A man photographs them.

Have you ever tried to hold a young bird in your hand? It is a real delight to feel their little plump bodies encased as they are in fluff and feather.

Never attempt to take an unfeathered youngster out of its nest; you are sure to hurt it, they are nervous and delicate little creatures. Even when feathered, it

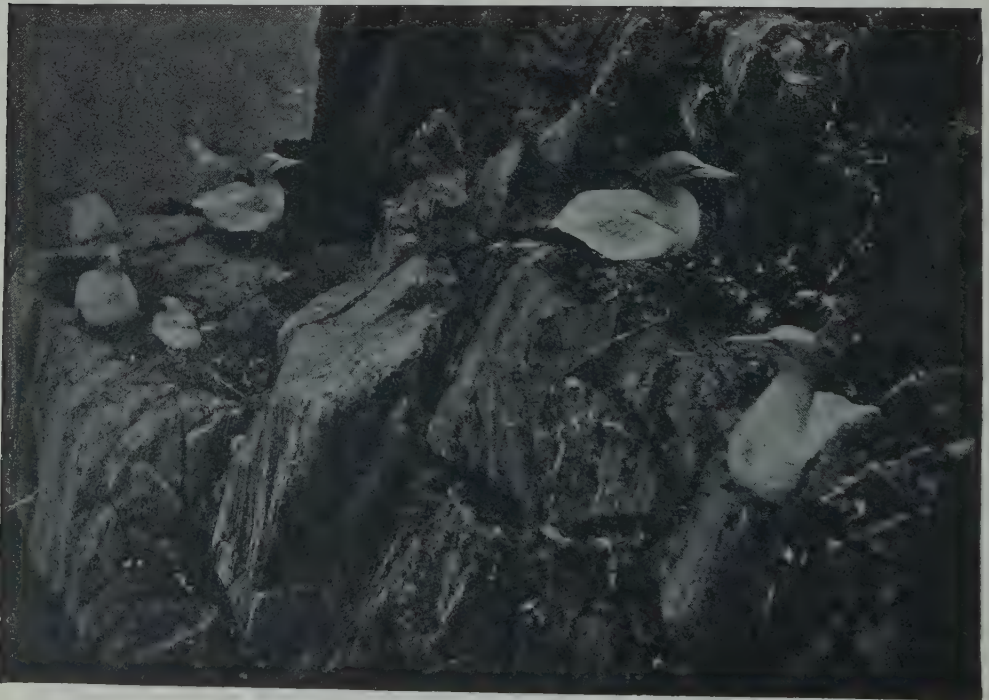
is well to leave them alone, as they are very apt to forsake the nest when removed. The restless spirit of the world seizes them, and in seeking pastures new they might possibly die of starvation or fall a victim to other enemies. There are exceptions to this rule, however. I know that fledgelings that are ready to run on issuing from the egg will gather and regather to the nest on the call that must be obeyed—the parental call.

Nature guards the young ground birds, as for example the Lark and Duck and Game birds, by giving them coloration in mimicry of their surroundings. It would be quite a simple thing to trample on a Lark's nest full of young, or a young and crouching Plover, without noticing them. In the town we have posts warning us to keep to the right, and in the country we will walk in the right if we watch every step we take. There is a marvellous world at our feet in the country places if we only look hard enough. The countryside has no more charming picture than that which may

often be seen of a row of young Long-tailed Tits being fed by their parents. Once in the vicinity of Loch Lomond I observed the young being fed. As a rule, only one at a time alighted to feed the youngsters. One little chap was inclined to be sleepy, but I noticed the parent bird would not allow him to miss his meal, even when clamouring brothers and sisters with argument of wide open mouth more insistently appealed.

As a rule, nestlings are fed according to their importunity. If they don't open their mouths they get nothing. Thus the survival of the strongest prevails. There are no hospitals or cripple homes for infirm nestlings in birdland.

The nest of the Long-tailed Tit is a very handsome structure. Lovers of birds, and happily their name is legion, give this nest pride of place as the most perfect specimen of bird architecture in this country. Elongated in shape, composed of moss and lichen, and wonderfully felted together with spider webs and lined with feathers, it is indeed a fairy home.



SOLAN GEESE.

Over two thousand feathers have been found inside this little palace.

It is a real joy of country life to see such a family of Tits following their parents, in their curious way, hide and seek or "follow the leader" fashion through the hedgerows and fields and leafy woods. They keep together in this merry march, uttering a quaint little monosyllable, until the spring, when

ground, or require to battle for life at an early stage, are early well protected with feather or down, while birds reared in an enclosed and comfortable nest have their down coats in all stages of degeneracy.

Notice how like a powder-puff is the fluffy youngster of a Solan Goose or Gannet. His blanket coat is of the most pleasing white down. A white spot on the tip of the upper mandible shows the



YOUNG SWALLOWS DISCUSSING THE WEATHER.

the joys of pairing break up the happy family circle.

We have all at some time, I hope, made the joyful discovery of a nest of young Thrushes. The photograph (p. 855) shows them inquisitively watching the photographer and camera, and no doubt wondering if this is a new feeding machine. While taking this photo the old birds, as is their wont, were screaming around, much concerned about the fate of their babies.

Scotland has not been honoured with the Nightingale, and has to wax eloquent over the singing capacity of her Thrushes, which have been well called the "Scottish nightingales." The lovely mottled breast of these handsome birds, which is conspicuous for its beauty, is seen in the young in the photograph. When very young warm nest birds do not require so much down, and are born practically naked. The principle in Nature seems to be that chicks which are born on the

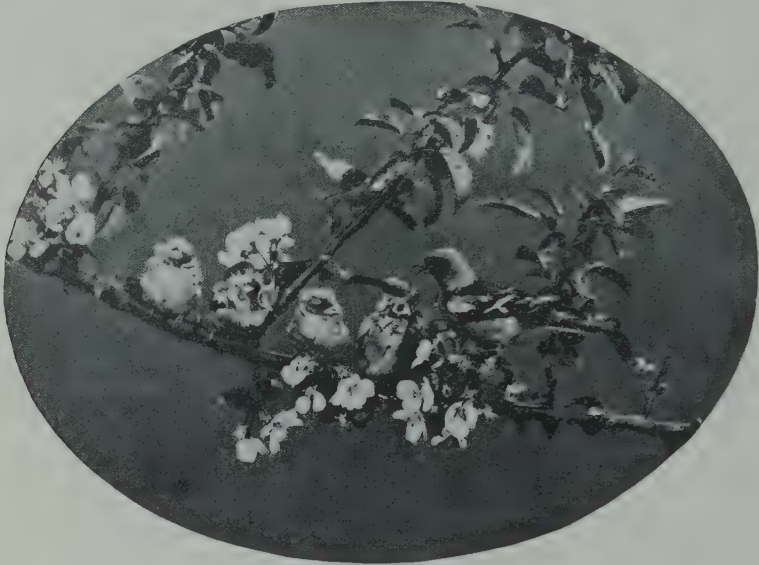
weapon by which he hammers his way to the outside world from the inside of the egg. When younger he was an ugly, little, black, sprawling rascal as bare on the skin as the back of your hand, and by sound and appearance not unlike a little puppy dog. To be down among them on the cliffs of the Bass Rock or Ailsa Craig is an experience unforgettable. The photograph of the Solans sitting on their nests (p. 850) gives you an idea of the boldness of these magnificent birds. I could have touched them while taking the picture. The parent Solan or Gannet, by means of his gular pouch, is able to deposit a fairly large quantity of food when feeding his family of one. On this food, composed of herring fry, about three inches of length, the youngster gorges himself. You will find balls about one and a half inches in diameter on the edges of many of the nests. These have been regurgitated by the parent birds, and constitute a granary for their young.

The number of Gannets which annually visit the Bass Rock is estimated at from sixteen to twenty thousand, and they are regarded as pests by fishermen on account of the enormous quantity of herring fry they consume.

The two photographs of young Blackbirds show different stages of development though not the same birds. The black-moors on the tree are more at ease than

thus no necessity for them to turn round, which is a very handy acquirement in confined apartments.

The ways of the Starling are sometimes curious in her efforts to feed her young. Once while photographing this bird I noticed that it did not know its nest hole "right off." There were two nests in one part of a bridge, and a Starling would often alight at one hole



WILD CHAFFINCH FEEDING YOUNG.

the tribal members in the nest. This sable-coated songster is as well known as the Thrush, and almost as much admired. His song appears to be a more cut-and-dried production than that of the Thrush. The Thrush is an *inspired* musician. The Blackbird would appear to be always going over his musical lesson, and I think he learns it exceedingly well. The mellow liquid notes are very refreshing; and when this sweet singer is perched on the "highest turret" of spruce or fir, his notes gather a new meaning and give satisfying enjoyment.

Where young birds are brought up in holes Nature adapts them to their surroundings. For example, Woodpeckers have little excrescences on their back joints, and they go back and forward in their confined homes with a shuffling gait which is remarkably swift. There is

first by mistake and then go over to the other, which it entered.

Starlings have often been suspected of polygamy; but if you get a nest containing more than six eggs—the number they generally lay—you must not judge too hastily. It is quite possible that in some cases, at least, the first female may have died and the widower taken to himself another wife.

Young Swallows and House Martins appeal to us chiefly because of the marvellous rapidity of even their early flights. Occasionally you may come across a young Swallow or House Martin too weak to fly. In such a case carefully and tenderly examine the bird and you will most likely find spidery-looking insects under its wing.

When I first saw these parasites I did not like to touch them, but one must



YOUNG BLACKBIRDS' FIRST OUTLOOK ON THE LARGER WORLD.



YOUNG BLACKBIRDS IN NEST.

overcome such feelings and carefully pick these degraded flies off the birds. The flies are quite noticeable, having sickle-shaped wings, which are of no use for flight. These flies being strong, and the bird's beak being weak, it is impossible for the poor creature to get rid of them, and so the chick weakens and dies. It is among the later brood of Swallows and Martins you will generally find this parasite; the reason is obvious, the flies having been gradually multiplying during the summer.

Even the best of things are puzzling at times. To the average man it is too much of a puzzle to distinguish the House Martin from the Swallow. He gets out of the difficulty by calling them both Swallows. The

photographs on pages 849 and 851 will help him.

The Swallow, or "Chimney Swallow," is clearly distinguished from the House Martin by the dark chestnut colour of the throat.

One of the greatest miracles in Nature is the migration of birds, and when we remember that the Swallow tribe winter even as far away as South Africa, we can only marvel and admire. Over these thousands of miles of sea and land will a Swallow come back in the spring, wafted by the soft south winds, to its little nest perhaps in a byre, in a shepherd's shieling hidden away in the Scottish hills.

Just before going for "winter" holidays Swallows gather, as a rule, near water, and it is this strange habit that has most likely

given rise to the stupid notion that they hibernate in the mud or soft ground beneath the water. Gilbert White in his classical pages discusses this idea, and, of course, refutes the possibility of such a thing.

One of the commonest, prettiest and boldest of our British birds is the Chaffinch.



WILD CHAFFINCHES ON A CRAB-APPLE TREE.



YOUNG THRUSHES IN NEST.

Its cheery "pink pink" resounds along the country road from hedge and tree.

With blue cap and black, white and saffron on wings and breast, it is a conspicuous and delightful little bundle of activity, and has endeared itself to us all. The nest is a compact little structure, felted together with moss and lichen and cosily lined with hair and feathers. This nest may be frequently found in a hawthorn hedge.

The protective coloration of the outside of the nest corresponds

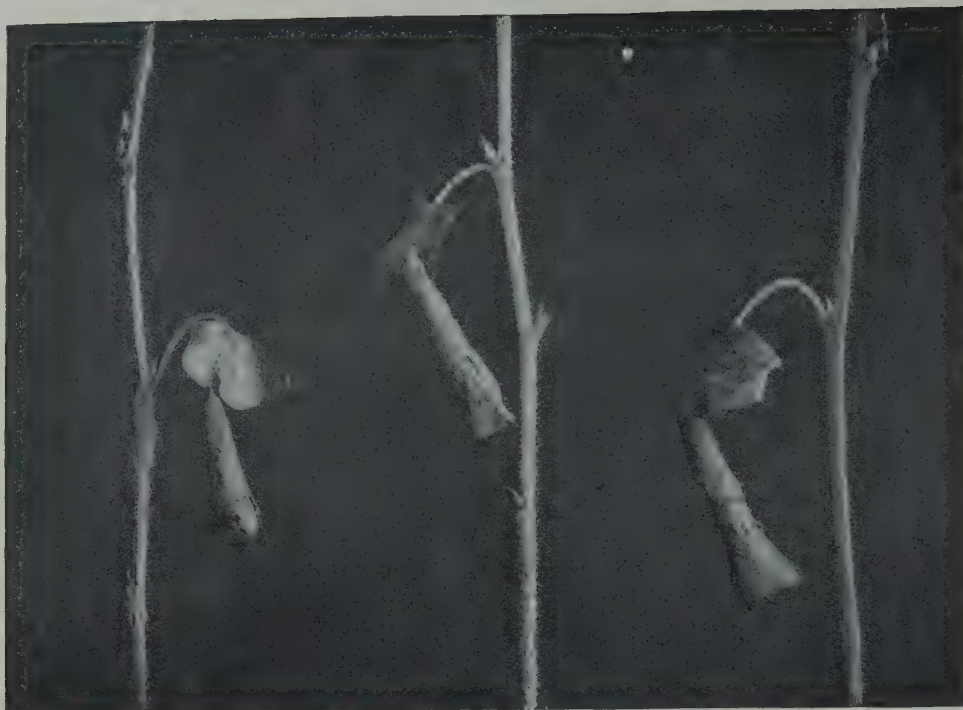
so exactly at times to the lichen, etc., on the tree on which it is built that you might be looking at it and yet not see it. On the other hand, I have found the outside of the nest interspersed with small pieces of paper—sometimes relics of the paper chase—which give the nest an ornamental rather than a protective appearance.

If you wish to come closely in touch with Nature, buy a camera and begin photographing her. A photograph of a living bird is better than a dozen stuffed birds in a glass case. To photograph that bird feeding its

young is one of the most exciting and wholesome things in life. It is pleasure without pain.



DUCKS ON POND.



LEAVES ROLLED BY LEAF-ROLLING WEEVIL.

THE BIRCH LEAF-ROLLING WEEVIL

By HAROLD BASTIN

Illustrated from Photographs by the Author

IN the whole realm of Nature I know of nothing more astonishing than the behaviour of certain small beetles of the Weevil class which are grouped by naturalists in the families *Rhynchitidae* and *Attelabidae*. These insects are known popularly as "Leaf-rollers," because the females, during the period of egg-laying, prepare leaves in an elaborate manner to serve as food and dwelling-places for their young. Both families are represented in the North American continent; but in Europe the species are much more numerous, while one (*Rhynchites bacchus*) has gained notoriety as a "pest." It mutilates vine leaves in such numbers as

seriously to affect the growth of the plant. But it is with an allied British species that I propose briefly to deal. It is known to science as *Rhynchites betulae*. This high-sounding name, being freely translated, signifies "the nose one of the birch tree," and is singularly appropriate, for it indicates at once the beetle's prominent feature—*i.e.* its snout or rostrum—and its place of residence. Young birch trees, from five to ten feet high, growing at the outskirts of plantations, should be searched during the summer months by those who desire the acquaintance of the "nosey one."

Probably the searcher will first find

only the Weevil's work. Some of the birch leaves are cut and rolled up in the form of little "screws," such as a grocer makes of the papers which are destined to hold pounds of moist sugar. A photograph showing three of these leaves is reproduced on page 856, and when such leaves are detected upon a birch tree, the Weevil herself is not likely to be far off. On seeing her for the first time the reader will, perhaps, find it difficult to believe that she can be in any way connected with the tightly rolled leaves. She is so insignificant—barely a quarter of an inch in length! Yet cut and roll the leaves she certainly does, as the reader may ascertain for himself if he be disposed to watch the somewhat slow progress of her labours.

Let us suppose that we have been lucky enough to discover a Weevil about to operate upon a birch leaf, and that we have leisure at our disposal to witness the completion of the work. The whole process may take as long as two hours, and it is seldom finished in less than an hour and a half; so that the watcher must be prepared to draw upon his stock of patience.

I should like, at this juncture, to emphasise the fact that it is the *female* Weevil alone who engages in the arduous task of leaf-rolling. He who in name is her lord and master is a mere looker-on—a pitiful nonentity striving to bolster up authority by means of futile officiousness and senseless meddling. I have seen him stand close to his mate while she is engaged in her toil, seeming to criticise, or perhaps to offer contemptuous words of advice. I have also seen him turn to flee when the tide of labour sets in his direction. Not that "my lady of the birch" is actually aggressive. She simply sweeps her slothful partner from the leaf by the sheer force of ceaseless activity.

To return, however, to the Weevil which is about to commence rolling. First, she does a deal of prospecting, moving deliberately about, both upon the upper and the lower surfaces of the leaf. We realise that the choice of a leaf is a matter of no small importance. At length, satisfied with her investigations, the insect makes her way to a point at the edge of the leaf, not far from the stalk, and, stand-



UPPER SIDE OF LEAF: THE BEETLE HAS JUST COMPLETED ITS CUTS.

ing upon the upper surface, makes a long, curving cut with her tiny jaws from the edge to the midrib. She then ascends the leaf for a short distance, and from the other side of the midrib makes another curving cut to the opposite edge. A beetle who has just completed her cutting is shown in the photograph on page 859.

In favourable circumstances this preliminary labour is accomplished in from ten to fifteen minutes. It is a fact worthy of note that the beetle works without the slightest hesitation, cutting the leaf-tissue readily and continuously. Yet the curved incisions, each of which resemble roughly the letter S, have been examined by mathematicians, who have (to quote Dr. David Sharp) "extolled them as being conducted on highly satisfactory mathematical principles." In a word, these curves are precisely those which are necessary to render the subsequent rolling of the leaf most easy of

accomplishment. Should the insect fail to project accurately these curves, she will fail also in her attempts to roll up the leaf. Indeed, I think that the Weevil's instinct is by no means infallible in this matter, and that faulty curves account for the many half-rolled and deserted leaves which one may find upon the birch twigs where the insects are at work.

But in the particular case which, in imagination, we have under observation, we will suppose that our Weevil's curves have been accurately projected. When she has finished the cuts, she takes a long rest—not, I believe, because she is fatigued, but in order that the pendent portion of the leaf may become more flexible. The uncut leaf is stiff with the pressure of the sap. But as soon as the cuts are made the vegetable tissue begins to wither, and becomes gradually quite flabby. We see, therefore, that the insect's long pause at this juncture is all to her advantage—may, indeed, be regarded

as part of her scheme. When, however, the leaf has become sufficiently pliable, the Weevil goes to its under surface, and standing close to the edge where her original cut begins, commences to roll one side of the leaf round an ideal axis by means of her legs. When watching her I have been irresistibly reminded of a man "on all fours" rolling up an immense sheet of linoleum.

As one observes the progress of the work, one realises how greatly the Weevil is helped by the curved incisions which she first made. These prove to be exactly what is needed to counteract any tendency to spring back on the part of the rolled-up leaf.

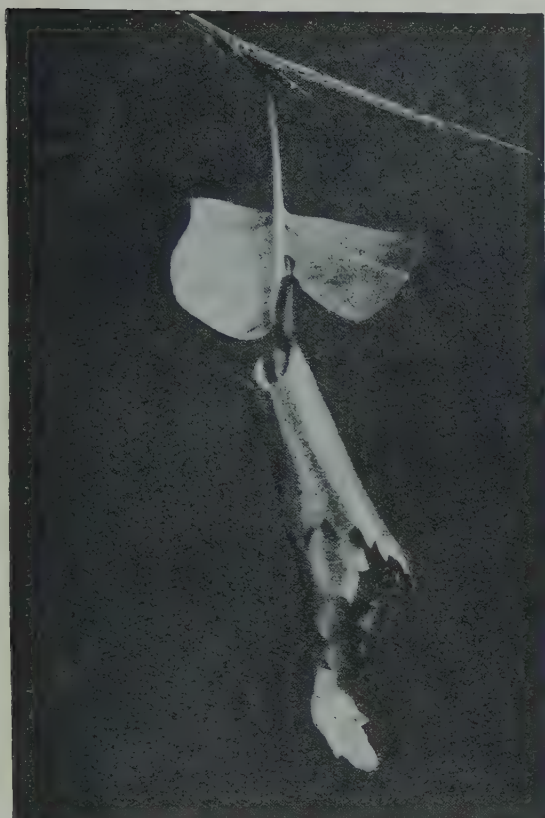
When the Weevil has rolled one side of the leaf to the midrib, she alters her tactics somewhat. Holding by the legs on one side of her body to the rolled-up part of the leaf, she drags at the unrolled portion beyond the midrib with her other legs. In this way she slowly draws the second part of the leaf round the part which she has already rolled, incidentally wrapping herself within the folds. When the stage shown in the photograph on page 859 is reached, she makes several incisions in the leaf-tissue and lays an egg in each. Thereafter she comes forth, tightens the roll, and fastens down the overlap by means of her jaws. The tip of the leaf now claims her attention. Of it she makes a second and smaller funnel, and bends this inwards so as to close the end of the first funnel.

Finally, the Weevil ascends the rolled leaf, and partly cuts through the midrib at the point where her first curved cut meets it. She appears to do this with a view to promoting that particular state of decay in the leaf which will render it fit food for the grubs.

If we trace the life cycle of *Rhynchites betulae* we shall only find additional cause to wonder at the behaviour of the adult insect. The eggs, which hatch in the rolled-up leaf, produce blind and legless maggots. These feed upon the leaf-tissue around them, and when full grown make their way out of the roll and drop to the ground, where, beneath the soil, they change to pupæ. In this state they pass through the winter, and in the early summer the adult beetle comes forth and



THE ROLLING HALF DONE.



THE ROLLING ALMOST COMPLETE. AT THIS STAGE THE BEETLE LAYS ITS EGGS WITHIN THE LEAF.

creeps up the birch stems. From these facts the reader will perceive that the newly emerged Weevil cannot, by any conceivable chance, have seen a rolled birch leaf. Thus, it is plain that imitation plays no part in the subsequent procedure of the insect. The elaborate cutting and rolling in which the Weevil engages can be explained only by employing the word "instinct," and this, as the reader will be well aware, is really no explanation at all.

The Birch Leaf-rolling Weevil is by no means the only English beetle which rolls up leaves. Nor does it confine its activities to birch trees. It may often be found hard at work upon alder bushes. Moreover, there are two species of the family *Attelabidae*—both of them beautiful, coral-red insects considerably larger than *Rhynchites betulae*—which roll up oak leaves and hazel leaves, each species accom-

plishing its work in a different and characteristic manner. These two beetles may be described as "locally common"—i.e. they are not always to be found when wanted, but when found they will be present in numbers. The writer has often observed the manner in which *Attelabus curculionides* rolls up its oak leaves, but considerations of space prevent a detailed description of its methods being added. Suffice it to say, that the insect proves itself equal in ingenuity to its relative of the birch tree, and that its rolled-up leaf, when finished, resembles a small thimble, or barrel, rather than a screw.

Exactly why these Weevils adopt the plan of leaf-rolling as a means of providing food and shelter for their grubs is not definitely known. Quite a number of species, which actually belong to the same genera, do not roll leaves at all. For example, a species of *Rhynchites* which is sometimes fairly abundant on hazel bushes, merely pierces the top shoots of that plant so as to arrest their growth, after having deposited an egg in each of them. Other species lay their eggs in the recently formed fruit of wild trees, afterwards duly making an incision in the stalk below, so that the fruit fails to develop

properly, and ultimately falls to the ground, where it continues to provide nourishment for the grub within. It is thus perfectly clear that leaf-rolling is by no means essential to the well-being of these insects, and why some of the species should have acquired the habit is a problem which must be left unsolved pending the further advance of science.



BIRCH LEAF-ROLLING WEEVIL
(Magnified.)

CHAPTERS IN PLANT LIFE

II—THE PLANT AND THE SEASONS

By S. LEONARD BASTIN

Illustrated with Photographs by the Author

THE changes which come over the world of plants with the passage of the seasons are the most distinctive features of the countryside. At the approach of winter the greater number of trees and shrubs, in common with most perennial species, pass into a state of quiescence from which they will not emerge until the arrival of the spring. Such a course is only possible in conditions which involve a cessation of vegetable activity that is practically universal. In the tropical forests the trees are almost without exception evergreen in habit, and it is necessary that they should be so, if they are to hold their own in the fierce struggle for existence. The welfare of the tree depends upon the extent to which it can keep the soil beneath it in a state of dense shade. Underneath the spreading branches the ground is littered with germinating seeds, only waiting for a few rays of sunshine to enable them to start into a vigorous upgrowth. Should the tree become denuded of its foliage for even a short while, it would soon find itself surrounded by a host of formidable rivals that might threaten its very existence. No such considerations arise in the case of trees growing in temperate climes for at any rate half of the year. In the bitter days of winter there is no fear that the myriads of seeds which lie buried in the soil will start into life. Even should they do so during the first few weeks of warm weather they will scarce have grown into small plants before the branches above them are thick with rustling leaves.

To the lover of Nature every spring-time comes with freshness, offering as it does a new opportunity to observe one of the most amazing sights in the whole

world. The bare trees, the leafless hedges, and the brown earth are in a few short weeks transformed as by the touch of a magician's hand. So great is the up-rush of life that it is quite impossible to separate oneself from the joyousness of the resurrection. It is interesting to dwell upon the underlying causes which bring about this annual change. The question is one which must often arise—how do plants know the seasons? At first sight it may seem that a renewal of activity is simply due to the fact that the cold weather is gone; but this does not offer a complete solution of the problem.

Late last autumn the conditions were for weeks as uniformly mild as they are at present, yet the trees did not start into leaf. It may be suggested that it is the increase in the intensity and the amount of sunshine which arouses the plants from their winter slumber. This can hardly be the case with the large number of herbaceous plants with rootstocks inches below the surface of the soil, yet these respond to the call of spring no less readily than the deciduous trees and shrubs. Even more difficult to explain is the behaviour of the aquatic species, such as the Water Lilies. The roots of these plants are buried in mud many feet deep under water—how can they possibly be aware of the arrival of the new season? Yet quite early in the spring these plants begin to stir into activity. Most strange of all in connection with the problem of the plant and the seasons is the story of the *Soldanellas*, small plants which exist on the lower slopes of the Alps. When the flower stems are in their most active state of growth they release a considerable amount of heat. In this way they will bore a course up through

a thick coating of ice and snow to the light and air above, when by some means, of which we can form little idea, the plant is aware that the spring has arrived. There seems to be something more in the phenomenon than can be explained as mere mechanical cause and effect. Indeed, the sympathy of the plant with the seasons is surely one of those mysteries which are as inscrutable as life itself.

The spring is perhaps the most trying time of the whole year for the plant. Often enough the first few fine days which have given promise of coming summer are followed by rigorous conditions which would more properly belong to the depths of winter. Yet it is very rarely that any serious damage results to the young foliage, even if the dainty leaves have already left the protection of the bud cases. To examine the expanding shoots of the Horse Chestnut, is to find that each leaf is clothed with a downy substance which forms a perfect protection against cold.

In the case of a large number of plants the foliage is not expanded until it is in

an advanced stage; leaves rolled up or folded together are more likely to escape damage than those which are open. Another curious phase in the early development of the leaf is connected with the colouring of the tissue. Very young foliage is often of a reddish tint, a circumstance commonly to be seen in the case of Sycamore and Maple shoots. Crimson patches are also not infrequently seen on the upper surfaces of Hazel leaves. As well, the bud cases of many trees and shoots take on a bright crimson shade in the early part of the year. This is seen to great advantage in the case of the Lime trees. It is believed that this colouring is a protective measure, brought about to prevent an undue loss of heat. It has indeed been proved that the purple tinting on the under side of the Water Lily leaf is due to the presence of a curious pigment called anthocyanin, which has the remarkable property of changing light into heat. By this means the chilling influences of the water are controverted.

It is no hindrance to the enjoyment of



CHERRY LAURELS IN WINTER.

The drooping of the foliage during frost is valuable as a protective measure.

the spring day to consider the more immediate cause of the bursting buds and expanding leaves to be seen on every side. This is nothing less than the



WINTER.

resumption of the flow of sap—a process which has been almost entirely suspended during the last four or five months. All through the winter, growth on the part of the deciduous trees has been at a standstill, and only sufficient of the vitalising sap has been in circulation to keep the specimen from dying altogether. It must never be forgotten that when the tree is in its fullest state of activity, there are two very distinct currents of sap—the ascending and the descending flow. It is not an inapt illustration to compare the starting into growth of the tree to the lighting of a lamp. The developing leaves appear to exercise just that drawing power upon the liquid imbibed by the roots from the soil, which the burning wick does upon the oil in the reservoir.

The course which the sap pursues in a typical tree may be briefly outlined. Starting at the root, the fluid is carried upwards through the cells of the newer wood to the upper surface of the leaves. At this stage the sap is really little more than plain water, combined with certain inorganic matter taken from the soil. The force with which the sap rushes upwards is very great, and by way of

experiment a vine stem was severed a few feet from the ground in the spring-time, and a bladder tied over the cut end. In a short while the bladder was greatly extended, and finally burst, unable to sustain the tremendous pressure of the sap flow. It is not until the passage of the sap along the upper surface of the leaves that the great change comes in its composition. Exposed to the magical influence of the sun and air, the fluid is completely elaborated. By a process which is not fully understood the inorganic material taken up by the plant from the soil is changed in such a way that it can be assimilated by the tissues of the vegetable. The sap is now very much altered in its consistency. A large proportion of water has been evaporated, and the fluid is thick and rich in nutrient matter. Moreover, it will have acquired certain peculiar properties—in the case of the Oak, for instance, these being of an astringent nature. The course which the sap now pursues will take it along the under side of the leaves, through



SUMMER.

The marvellous change which three weeks of spring weather brought about.

the new tissue, and so back to the roots again.

All the summer long the leaf lives a life of intense activity, manufacturing a store of food material which will be put

aside in various parts of the plant. With the coming of the autumn, however, the vitality of the leaf steadily declines, the sap movements become very slight, and the time has come for the organ to be separated from the tree. So far-seeing is Nature, that the leaf is scarcely developed ere preparations are commenced for the severance of it from the twig. Quite early in the history of the leaf at the point of union between the stalk and the stem, a special arrangement of cells is

it does not leave a raw and bleeding wound behind such as would be produced by the forcible pulling of the leaf from the branches. The very layer of cells which brought about the separation has also ensured the welfare of the twig from which the leaf has been removed. A thin veil is spread over the point of cleavage, so that there is never any open surface exposed to the air at all. There are few more beautifully contrived processes in the natural world than this fall of the leaf,



CHRISTMAS ROSE IN WINTER.

formed. This has been called the layer of separation, and consists of a number of cells running at right angles to the tissue of older formation. The greater the age of the leaf the more markedly does the line of separation appear; and as the processes of assimilation begin to slacken and the moisture evaporates, the severance of the organ is only a matter of time. Finally, the presence of organic acids so weaken the cells that the leaf will perhaps fall by its own weight; in any case the first gust of wind will be sufficient to complete the fracture.

When the stalk has become detached

with which the tree passes into its winter rest. And so the leaves, often brightly coloured as the result of the chemical change which has taken place in their tissues, flutter to the ground—there to lie until decomposition gradually changes them into soft mould. In this way a bed of fine rooting material is formed for future generations of seedlings.

It is, indeed, a wrong impression to consider the autumn as simply a time of decay, for much is accomplished at that period by way of preparation for the following spring. Pull a Chestnut bud to pieces just before the tree loses its

foliage, and it is possible to distinguish the leaves—on a small scale, certainly, but in a wonderfully perfect condition. Several pairs of leaves may be readily distinguished all packed away in downy material, quite ready for the development which will come with the spring. This being so, the protection of the buds against the rigours of winter is a matter of first importance in the life of the plant. Perhaps one of the most obvious features in our Chestnut bud is the gummy substance coating the exterior, and which under the influence of warm sunshine becomes very sticky. This material is most valuable on account of its non-conductive properties, and doubtless plays a large part in shielding the contents of the bud from cold. Apart from this, however, there are several layers of scales which play the chief part in checking the penetration of cold to the immature leaves.

Generally speaking, in nearly all trees these scales represent modifications of leaves which have been arrested in their development or even have partially died, and have thus become horny in texture. In plants such as the Lilac and Rhododendron the bud scales are modifications of entire leaves, and keep green throughout the winter. In one of our deciduous species, the Wayfaring Tree (*Viburnum Lantana*), the lowest leaves of all act as bud scales, and these, owing to a woolly coating, are able to survive through the winter and finally develop as ordinary foliage leaves.

It is a wise provision which has ordained that the tree should become denuded of its foliage before the winter. This season is a time of rough weather, when the strong gales sweep over the country and threaten to destroy all before them. Any



PROTECTIVE BUD COVERING OF
A SYCAMORE TREE.

of the large forest trees in full leaf would offer a tremendous resistance to the wind and, of course, suffer accordingly. Now and again, when a severe summer gale has visited a part of the country which is wooded, it has been possible to gather some idea of the havoc which a strong wind works among trees in foliage. It is interesting to observe that practically all the so-called evergreen trees which are indigenous to temperate regions produce comparatively small leaves. Of these the great tribe of Conifers are typical, which with their needle-like leaves do not offer serious resistance to the wind.

Apart from the Firs, the trees and shrubs which keep their foliage all the winter produce comparatively small leaves, and these are mostly of specially thickened texture so that individually they may not suffer from wind damage. Round the border of the Holly leaf may be traced a kind of selvedge, formed of thickened layers of cells. This does much to prevent the leaf from being torn in rough weather. The small size of the leaves in the case of these evergreens is also to the advantage of the plant in another way, by preventing snow accumulation. The thick leafy branches of the deciduous trees would provide a lodgment for the falling flakes to such an extent that serious bough breakage would result. The dry particles of snow find little to rest upon in the slender foliage of the Fir or the small, narrow leaves of the Yew.

At all times cold is a great menace to plant life, and a period of severe frost is full of danger to the unprotected vegetable. Yet the low temperature which would threaten to destroy the plant seems to bring about an alteration in the bearing

TREES

BUDS—STRUCTURE AND DEVELOPMENT

Specimens required :—BUDS OF SYCAMORE, HORSE CHESTNUT,
ASH
(February and March)

Structure

Examine buds of Sycamore, Horse Chestnut, and Ash, noting particularly the bud scales. Note arrangement of scales—the best possible for protective purposes. Observe sticky matter on Horse Chestnut bud and note protective function. Remove bud scales and note silky hairs carefully shielding tender bud leaves within. Note leaf scar below bud. This is very clearly marked on the Horse Chestnut. Also observe ring of marks made by last year's terminal bud. This is a series of bud scale scars. Thus the amount of growth made by the stem in a year may be determined.

Cut sections through and across buds. Draw diagrams to record all specimens examined.

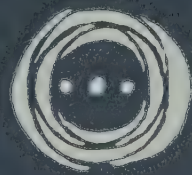
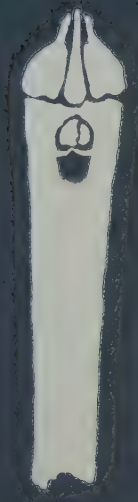
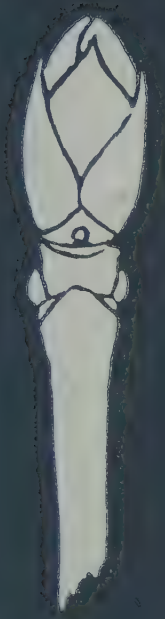
Note functions of bud scales :—

1. To maintain temperature within.
2. To prevent loss of moisture by evaporation.

Development

In April collect buds of the same trees. Examine carefully and note bud scales. These have burst open and turned backwards, subsequently dropping to the ground. Note growing part of bud, which will make new growth for the year. In November the buds present the first phase of development.

Buds · { structure. development



Sections

I. Sycamore

II. Ash

III. Horse Chestnut

Buds are protected by bud scales which overlap like tiles on a roof. In horse chestnut buds the scales are covered with sticky matter which protects the bud within.

of the foliage that is valuable as a protective measure. It is seen that during very cold weather many plants droop their leaves, and in this manner prevent a serious loss of natural heat. Most people must have observed how different is the bearing of the Cherry Laurel on a frosty morning to what it is in mild weather. There is little doubt that the leaves would be badly damaged by the cold if they were held out in the normal fashion.

A very considerable number of plants are herbaceous in habit; that is to say

deal below the surface. The forms taken by roots are very varied, even if we put aside altogether the underground processes such as bulbs, tubers, and rhizomes, which are, after all, only modified stems. In most cases those parts of the plant beneath the surface are to be regarded as storage chambers upon which the specimen will draw when it is called upon to start its spring growth. With some species the amount of energy stored up is very considerable—sufficient to bring the plant to its maturity if moisture is obtain-



PROTECTIVE SCALES FROM CHESTNUT BUD.

they do not form any woody material which lasts through the winter above-ground. In these cases it is seen that towards the end of the summer there is a decided slackening in the activity of the plant, and finally the circulation of the sap ceases altogether. In fact, all the life of the plant vanishes underground. That there is a very real purpose in this behaviour on the part of the herbaceous species is certain; most of these plants are decidedly tender in habit, and few of them are able to produce stems fitted to cope with the rough weather.

Though there is nothing to be seen above-ground when the herbaceous plant has retired to rest, there is a very great

able. Thus it is seen that a Hyacinth will produce leaves and flowers grown in a vase of plain water.

All through the winter millions of seeds have been lying in the earth. These have remained in a state of suspended quiescence, just in the same condition as when they tumbled, brown and ripe, from the parent plant. It is always somewhat of a mystery as to how it is that the seeds are so well planted. By some means or other Nature generally manages to get most of her seeds covered in before the winter arrives. There is little doubt that the earth-worms take on a large share of the work. During the moist autumn weather these creatures work

comparatively near to the surface, and their countless upheavals of soil go a long way towards covering in the seeds. Seed vessels with long appendages, such as those of the Sycamore and Lime, may often be seen pulled down into the soil, having been treated in much the same way that the worms deal with leaves. Acorns, beech-masts and other edible seeds are stored away in holes in large quantities by small animals, such as squirrels and dormice, which inhabit our woods. The majority of them are forgotten altogether by the little creatures, and many a tree must owe its start in life to the efforts of these tiny gardeners. In addition to the work of these animal agents, the heavy rains of autumn must wash many of the smaller seeds into the soil, whilst the shower of drifting leaves will cover up even a larger number still.

What an alteration is brought about in the condition of the seed by the coming of the spring! With the increasing powers of the sun the cold earth becomes warmer every day, and this rise in temperature is the signal for which the seeds have been waiting. The gentle showers of

spring water the earth, and the moisture soaking inwards through the husks of the seeds, stirs the living matter to activity. As we shall see elsewhere, the store of food materials is at this time converted into a form available for the immediate use of the little plant-to-be. It is interesting to see how cautiously the plantlet puts in an appearance at first. The small stem arches its way through the ground, and the tender leaves hang down, until they are more developed. During the spring weather, which is usually of a fickle character, we may feel certain that the drooping, huddled bearing of the seedling's initial leaves affords a real protection against cold.

In defiance of weather conditions a few plants have elected to come to perfection right in the middle of the winter season. Of these the Christmas Rose (*Helleborus niger*) is perhaps one of the most striking examples. It is interesting to see the manner in which the flowers of this plant are protected, so that they may not suffer from the cold rains of December. The bud of the blossom is of a pendulous habit, and even when the



SUMMER: SHOWING ALL THE AQUATIC PLANTS ABOVE THE WATER.

flower is fully expanded the essential organs are perfectly sheltered by the encircling sepals. In passing, it may be mentioned that the petals of the Christmas Rose are contracted into small linear bodies, hardly exceeding the stamens in size. The flowers of the Hellebore seem to be able to hold over their own development for almost any length of time without injury until a fairly favourable spell of weather arrives.

The earliest arrivals of the spring-time will often have to cope with spells of bad weather. That typical flower of the new year, the Snowdrop, is well adapted to meet almost any conditions. Owing to its drooping habit the close-fitting petals form a most perfect little roof to protect the delicate essential organs. A few weeks later, when the Crocuses put

in an appearance, there will be more sunshine, but the weather is still in an uncertain state. Note the white protecting sheath which encloses the whole shoot until warmer conditions makes it safe for the leaves and flower-buds to venture out. When quite open the Crocus-blooms face right up to the sky and are exceptionally exposed, but it is only in direct response to the solar rays that the flower will display its shining corolla. On dull threatening days the floral envelope is tightly closed, so that there is no possibility of any harm coming to the golden anthers. In much the same way the golden-yellow Coltsfoot, one of the earliest of our wild flowers, is so sensitive that it never by any chance opens unless the day is bright and warm.

S. LEONARD BASTIN.



WINTER: ALL THE PLANTS DISAPPEAR BELOW THE WATER.



FEMALE OF THE GREAT GREEN GRASSHOPPER.

BRITISH GRASSHOPPERS

By DOUGLAS ENGLISH, B.A., F.R.P.S.

Illustrated with photographs by the Author

THE Praying Insects or Mantids, Leaf and Stick Insects, Cockroaches, Earwigs, Short-horned Grasshoppers, Long-horned Grasshoppers and Crickets, constitute a somewhat heterogeneous Insect Order known as the Orthoptera.

The Order admits of a natural division into two groups. The first of these embraces insects whose hind-legs are not markedly disproportionate, and whose normal method of progress is, as their name *Cursoria* suggests, a run.

Of this group we have about a dozen indigenous species. Three are Cockroaches, all, fortunately, of an out-door habit, and the remaining eight or nine are Earwigs. Of recent years several species of Stick insects have been successfully bred in this country, and records of their capture at large, more especially in the western counties, whose climate apparently suits them, have been not in-

frequent. It is possible that they may permanently establish themselves, and there seems to be no reason why an attempt to introduce some of the quaint, consequential, and, it must be confessed, somewhat uncanny-looking Mantids should not be equally successful.

The members of the second group are known scientifically as *Saltatoria*, and popularly as Grasshoppers, or Locusts. In the majority of them the development of the hind-legs ensures a remarkable leaping power, but is a serious handicap to any other method of progression. We have in this country about a dozen Short-horned Grasshoppers (diminutive Locusts), nine Long-horned, and four Crickets. Our lists are not infrequently increased by the sporadic appearance of Continental species, some of which may have been blown over, while others have been accidentally included in consignments of fruit and vegetables.

For an interesting record of the latter accident I am greatly indebted to Mr. O. H. Latter, the species in question being a male of *Acridium Ægyptium*, a South European Locust, who emerged from a hamper of cauliflowers imported in 1904 by a Godalming greengrocer. A cattle drover was called in—presumably armed—but the result of his good sense in bringing the insect to Mr. Latter alive, is that I am enabled to include a picture of it set so as to display the remarkable

spikes on a Grasshopper's shins, which terminate just in front of the tarsal joints with two or more quite formidable spurs, serve, in some fashion, as offensive or defensive weapons. In the case of our small Field Grasshoppers the extreme ease with which the hind-leg is dislocated at the hip-joint precludes the likelihood of their habitually kicking in self-defence. The only British insect who, in my experience, kicks with a will is the sturdily built Field Cricket.



TWO MALE BUSH-CHEEPS (*T. CINEREUS*) PREPARING FOR COMBAT.

attitude which it adopts when frontally attacked. Mr. Latter's description is that it "swings its hind-legs forward and makes a vicious upper cut" with the spines which arm its shins. The force of this slash, or kick, is sufficient to draw blood from the finger.

It should be noticed that this Short-horned Locust is an enlarged edition of our Common Field Grasshopper, and it may be well to point out that all "Locusts"—using the word in its generally accepted meaning—have *short* antennæ, and for this reason are referred to the Acridiodea, not, as might reasonably be supposed, to the "Long-horned" Locustidæ.

Though, with the possible exception of the Great Green Grasshopper (*Locusta viridissima*), none of our British Saltatoria are sufficiently well armed to do any but trivial damage to the human hand, there can be little doubt that the twin rows of

Grasshoppers most frequently display their resentment by the emission of a dark coloured fluid from the mouth. I have no knowledge of the chemical composition of this fluid, but the fact that, in the case of one magnificent Long-horn (*Decticus verrucivorus*), it is used as a remedy for warts, points to the likelihood of its being corrosive.

The great variation of colour in Short-horned, as opposed to Long-horned Grasshoppers, may be a general protective adaptation to their surroundings. A leaf-green body colour is, of course, a specialisation, and is to be met with chiefly in Long-horned Grasshoppers who habitually perch in the green some distance above ground level—in *Leptophyes punctatissima*, for example, who affects the sunny side of high nettles; in *Meconema varium*, a "tree" Grasshopper mostly found on the oak and hazel; in *Xiphidium dorsale*, and in the Great Green Grasshopper

(*Locusta viridissima*). The only brown Long-horned species at all common in this country is the Bush-cheep (*Thamnotrizon cinereus*).

Short-horned Grasshoppers seldom give one the impression of being green all over, and a close inspection usually shows that their colour is composite in origin, and that it depends partly on the development of their wings, and partly on individual variation. As an aid towards the distinction of species the colour of Short-horned Grasshoppers is therefore of little importance, though it may perhaps be mentioned that *S. viridulus* has a greater tendency than any other common species to being a delicate rose-pink.

The differences between Long-horned and Short-horned Grasshoppers are not confined to external structure, but extend to habits which would seem to be, in a sense, independent of structure. The epithets "Long-horned" and "Short-horned," of course, have reference to the antennæ, which, when perfect, are considerably longer than the body in the adult Long-horn, and in the immature so much longer that one wonders at the ability of the little creature to control them. The numerous segments of which these antennæ are composed can be distinguished with a pocket lens, and in certain species, *M. varium* and *L. punctatissima*, for example, they are beaded

at every sixth or seventh joint. The antennæ of our Short-horned Grasshoppers, which are always shorter than the body and never have more than twenty-five to thirty joints, are important as affording a generic distinction. In most British districts the "myriad cricket of the mead" is a Short-horned Grasshopper, whose thread-like antennæ vary very slightly in thickness from the base to the tip. This regularity in thickness stamps their owner at once as belonging to the genus *Stenobothrus*. It is probable that he will be either *S. viridulus*, who, as has been mentioned, is often pink, or *S. bicolor*, who is often the same colour all over. Should, however, a Grasshopper be taken whose antennæ are clubbed at the tips, he must be referred to one of the three species of *Gomphocerus*, and he is most likely to be *G. maculatus*, a small, spotty, greenish Grasshopper who is not uncommon. It needs sharp sight to distinguish the number of tarsal joints on a Grasshopper's foot, but it is distinctive of Short-horned Grasshoppers that these should be three in number, whereas in Long-horned Grasshoppers they are four.

To distinguish between the sexes of Short-horned Grasshoppers needs a very careful examination and some knowledge of insect anatomy. The mature female Long-horn, however, is distinguished at



THE GREAT GREEN GRASSHOPPER (*L. VIRIDISSIMA*) INVESTIGATING A SHORT-HORN (*STENOBOTHRUS*).

The relative size of the two species can be well seen.

once by the remarkable prominence of her ovipositor, and, in some species, by the absence of wings. The ovipositor, which may be described as "sabre shaped," and whose form in different species can be seen in the illustrations, consists of two similar and parallel blades (formed by the fusion of several others), which admit of sufficient separation to allow the passage of an egg between them, and whose rigidity, when closed, permits of the insertion of the

months, and are usually six or seven in number. In the case of *T. cinereus*, and *L. punctatissima*, I have seen the insect devour its cast-off skin with evident relish.

In *L. punctatissima* the appearance of the ovipositor is startlingly sudden. It springs out fully formed, giving one the impression that it has been lying concealed, possibly folded back under the old skin, for some time previously. At each subsequent moult its form is modi-



1, LARVA; 2, NYMPH OF THE BUSH-CHEEP (*T. CINEREUS*).

instrument up to the hilt in some suitable crevice. In depositing eggs the Long-horned Grasshopper straddles across the hole selected and bends the ovipositor downwards. I fancy that most British species lay their eggs in the ground, but it is said that *M. varium* lays in oak-galls, using, of course, the hole through which the gall-fly has emerged.

The development of the ovipositor in the female is like the development of wings in the male—deferred until the insect is nearly mature.

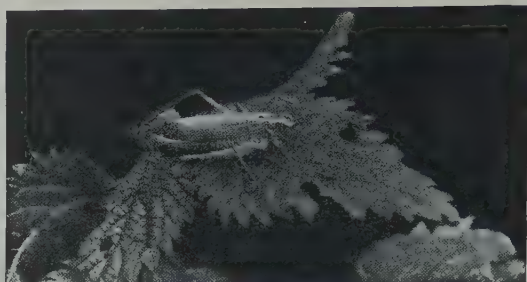
The metamorphosis of Orthoptera is incomplete. The transitions—larva to pupa or nymph, and nymph to imago—are so gradually accomplished that it is impossible to fix dividing lines between them. Perhaps the first rudiments of wings mark the attainment of the nymph or pupal stage.

The growth of young Grasshoppers, who hatch in late spring and early summer from eggs which have in most cases been deposited in the previous autumn, is assisted by a series of complete moults. These extend over a period of about two

fied, so that apart from the inevitable deformations which occur after death, considerable caution is needed in distinguishing the species of even live Grasshoppers by the shape of their ovipositors.

Immediately after a moult, a Grasshopper is a limp, anæmic-looking creature, who is rendered peculiarly helpless by the softness of his integument. Until this has been hardened by exposure to the air (it may be mentioned that his hind-legs are nearly as soft and flabby as the rest of him), he is incapable of violent movement, and is consequently defenceless. The process of hardening is, however, a short one. Within twenty minutes or so he will be found to have recovered, indeed, improved upon his previous colour, and to be in the pink of athletic condition.

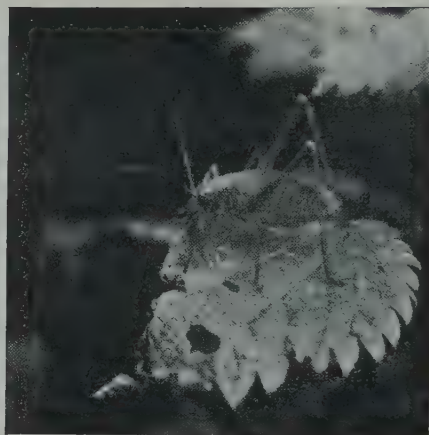
Short-horned Grasshoppers are fair fliers when the wind helps them, though they seem quite incapable of steering a definite course. In connection with their breathing apparatus—a system of air tubes (*tracheæ*) whose communication with the atmosphere is effected by rows of air



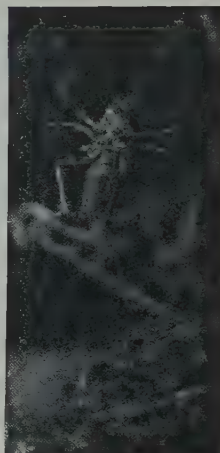
1



2



4



3



5

- (1). THE TREE GRASSHOPPER (*MECONEMA VARIUM* ♀).
 (2, 3). THE BUSH-CHEEP (*THAMNOTRIZON CINEREUS* ♂).
 (4). THE NETTLE GRASSHOPPER (*LEPTOPHYES PUNCTATISSIMA* ♀).
 (5). THE BUSH-CHEEP ♀.

In 1, 4, 5 the ovipositors should be noticed, in 2 the stridulatory apparatus in the form of scale-shaped elytra on the back.

holes (*spiracles*) on the sides of the body—they possess, like dragon-flies, bees, and many other flying insects, internal air-sacs which are capable of considerable expansion. It would appear that the dilation or contraction of these air-sacs is, in part, controlled by the insect and, in part, dependent on the space occupied by food and so forth in the insect's body.

In the destructive migrations of Locusts, which occasionally cause enormous damage to vegetation, it is probable that there is little true flying. The insects wait for a favourable wind, and, on its arrival, allow themselves to be wafted upwards and carried in the desired direction. Their muscular exertion is confined to travelling as far as may be on an even keel. It is an observed fact that a change of wind causes a swarm of Locusts to come to earth, and their ability to do this seems most easily accounted for by assuming that they have, when their bodies are empty (migration would be otherwise unnecessary), a fairly complete control over their air-reservoirs. The appearance of an approaching swarm of Locusts has been likened by several observers to that of a snowstorm, and the weight of one particular swarm which passed over the Red Sea in 1889 was estimated at 42,850 millions of tons!

Dilatable air-sacs appear to be either rudimentary or wanting altogether in Long-horned Grasshoppers, and it is perhaps this deficiency which prevents their migrating, like Locusts, *en masse*, and which inclines them to a mixed diet of animal and vegetable food. Several of our Long-horns possess an ample expanse of wings, but none of them can be termed strong flyers. The utmost that can be said for the wings of either *L. viridissima*



THE SMALL WOOD GRASSHOPPER
(*TETRIX BIPUNCTATUS*).

At the top are two cabinet specimens which have not been in any way posed for the camera. The distinctive form of the live *Tettix* can be well seen in the two lower illustrations.

or *M. varium* is that they serve to break a fall. *L. punctatissima* has no wings to speak of; neither has *T. cinereus*.

I am inclined to think that British Long-horns are normally insectivorous when mature, and that they wait for their prey to come to them. Sometimes they will slowly advance to the attack (I have seen the Great Green Grasshopper so stalking a Burnet Moth), and, if the object aimed at happens to be asleep, he will be eaten—or at least the fat portion of him, the wings being, as usual, pulled off and thrown aside.

Besides the distinctive differences between Short-horned and Long-horned Grasshoppers which are to be found in the length of their antennæ, the development of their ovipositors and the nature of their food, a further and important difference exists in the character and mechanism of their chirrup. Mr. Malcolm Burr, to whose

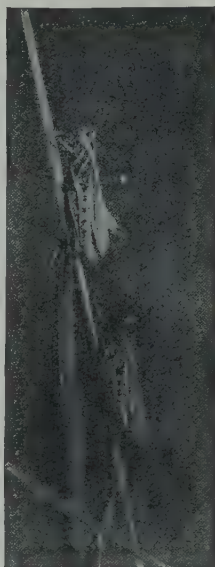
"British Orthoptera" I would refer the reader for an excellent systematic account of British Grasshoppers generally, describes the "chirrup," or stridulation, of three common Shorthorns as follows: *S. viridulus*—loud and prolonged, beginning low and gradually rising until it has reached a certain pitch; *S. bicolor*—a short "tzz-tzz-tzz"; and *S. parallelus*—"tss-ssz-szz-zzz-zz-z." The last phrase I must confess perplexes me, but I am relieved to find that British entomologists have as yet declined to follow the Americans in reducing Grasshopper notes to formulæ in which T = the temperature of the air, H the humidity, N the number of stridulations per second, and so forth.

In Short-horned Grasshoppers stridulation is effected by the friction of one hind-leg against the elastic edge of the wing-cover on the same side of the body.

To accomplish this the shank is brought up close against the thigh, and a quick fiddling motion imparted to the whole flexed limb. Its sharp edges, which in some species are beaded, grate on the edge of the wing-cover, and the variation of note in different species is to be accounted for partly by the specific difference of veining in the latter and partly by the structure of what is termed the "ear." This, in the Short-horned Grasshoppers, is situated on the first segment of the abdomen immediately above the articulation of the hind-leg and in front of the first spiracle. All that is externally visible in the common British species is a more or less oval depression. Within this is a tympanum or drum of tense membrane, which is described by Graber as having on its inner face two processes connected with a bag of clear fluid. The latter is in turn connected with the "auditory" nerve. That the whole is a sense-organ of some description admits of little doubt, and it is as likely as not that it may be an organ of hearing.

It is present in both sexes. If, therefore, we may assume that it affords a means whereby the female shall hear the male, we may also assume that it affords a means whereby the male shall hear the female.

I have never traced stridulation to a female Short-horn, but I know of no reason why she should not stridulate. Considering the complications which would arise if both male and female Grasshoppers sang one and the same tune; considering, too, the possibility of sympathetic tones ("resonators") linking the two sexes together—it is likely enough that female stridulations are not only invisible to human eyes but also inaudible to human ears. Many people are incapable of hearing even the male Grasshopper, though to others the shrillness of his song is almost painful. Forty thousand vibrations per second (the top



SHORT-HORNED FIELD
GRASSHOPPERS
(*S. VIRIDULUS*).

note of the pianoforte gives perhaps four thousand) is considered to be the limit of human audition.

In the case of one peculiar genus of Short-horned Grasshoppers, known as *Tettix*, stridulation, if it is accomplished at all, must be accomplished by a different mechanism. *Tettix* is unique in several respects. To begin with, he is honoured with one of the few pure Greek words used in scientific nomenclature, though it is doubtful whether the golden "tettiges," which, according to tradition, the Athenians wore in their hair to signify that they were autochthonous, were modelled on Grasshoppers or Cicadas. Both may be said, in a sense, to spring from the soil,

for both deposit their eggs below the surface. As a modern name for a genus of Grasshoppers, *Tettix* appears to have been first employed by the great French entomologist Latreille, and his countrymen—it would be difficult to overestimate the debt of entomology to French genius—appear to have vied with one another in naming the various species after devils. We find, for instance, in the old books *Tettix Lucifer*, *Tettix Beelzebub*, *Tettix Belphegor*, and *Tettix Asmodæus*. The reason for this nomenclature is not, as might be supposed, the preference of *Tettix* alive for warm surroundings, but the blackening and shrivelling of *Tettix* dead. The suggestive appearance of the cabinet *Tettix* may be seen in the illustration.

The living *Tettix* can be easily recognised by his small size, his sturdy build, and the lozenge-shaped appearance of his back, which is due to a hindward prolongation of the pronotum. We have two British species—*Tettix bipunctatus*, who has a roof-shaped pronotum and short wings, is extremely common; while *Tettix subulatus*, a more slender but equally short insect with a long, nearly flat pronotum and large wings, appears to be somewhat local.

Tettix bipunctatus, of whom alone I have certain knowledge, is a cheerful, robust little Grasshopper, who is active early in the spring, lingers late into autumn, and may possibly hibernate. He affects clearings in woods, and in suitable localities occurs in profusion. As one would expect from the development of his thighs, he is a prodigious jumper, but it should be noted that, contrary to the general rule among Grasshoppers, he has no resilient pads on his feet. One seldom finds a specimen with other than quite rudimentary wings, and I have never seen one fly.

In colour he shows extraordinary variation; browns and blacks predominate; but they occur in many shades and in many different dispositions. The pronotum completely hides the wings in all ordinary positions; so that if stridulation is accomplished

at all by the hind-legs, it must be by scraping on the pronotum.

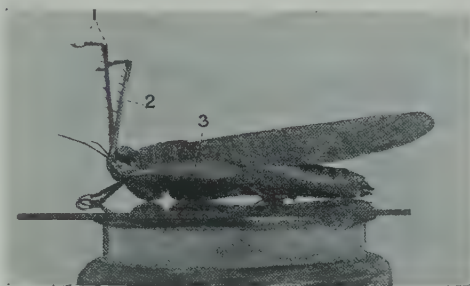
The stridulation of Long-horned Grasshoppers, which is of much greater carrying power than that of Short-horns, and is more closely allied to that of the Crickets in phrasing, is effected by the friction of the under surface of one wing-cover—usually the left—over the upper surface of the other. Stridulating wing-covers, which, as far as British Grasshoppers are concerned, exist only in the males, are partly, in some cases wholly, composed of tense, semi-transparent membranes stretched on stout branching nervures. The upper (left) cover is generally provided with a "rasp" nervure which engages with the edge of the lower (right) cover and so engenders a "shrill," which is intensified by the structure of both, and particularly by the presence in the latter of a semi-transparent circular "speculum."

The "shrilling" of the male Long-horned Grasshopper may be heard at any time during still warm weather, but

is most in evidence towards sunset, and may be prolonged far into the night. It is often difficult to locate. The note of *T. cinereus* (the Bush-cheep) resembles the squeak of a shrew mouse. His usual pitch is an inch or so above ground level at the bottom of the hedgerow. During the day time he often creeps out to sun himself, but so wary is he, and so quick to get to cover, that it needs a smart hand to catch him—and miss the thorns. It has been stated that the male of *T. cinereus* is somewhat rare. This has not been my experience, but I think that there

are fair grounds for supposing that in the case of Long-horned Grasshoppers and Crickets there is a tendency for the males to predominate in one brood, while the females predominate in another.

The "ears" of Long-horns are situated at the top of the tibiae (shanks) of the



ACRIDIUM ÆGYPTIUM (see p. 869)

1. The tarsal joints.
2. The tibia (shank).
3. The femur (thigh).

fore-legs; those of Crickets have a similar position. There is a decided tendency among Long-horned Grasshoppers to sit above ground level. They therefore affect the hedgerow, the nettle bed, and the coppice. Short-horned Grasshoppers prefer the grass. Either may trespass on the other's preserves; indeed, it is not unusual to find the Great Green Grasshopper at some distance from even a bramble bush. In certain favoured places in the south of England, one may count on finding *Stenobothrus* and *Gomphocerus* in the grass, *Leptophyes* in the nettles (by sweeping), *M. varium* on the hazels (Bignell's Tray), and *L. viridissima*, for all his protective coloration, moving one hind-leg, and so staring one in the face half-way up the hedgerow. I have already mentioned the wood clearing for *Tettix*, and the bottom of the hedgerow for *Thamnotrizon*. The latter is often in the heart of the wood also, and it is in small circumscribed sunny clearings that one has the best chance of taking him in all stages of growth.

DOUGLAS ENGLISH.

HOW TO KNOW THE SEASIDE FLOWERS—II

By the Rev. H. PUREFOY FITZGERALD, F.L.S.

Illustrated with Photographs by HENRY IRVING

IN a former article I dealt with a familiar group of seaside flowers to be found in most places around our coast. I now present a second group of interesting plants which, with a little search, visitors to the seaside may frequently discover.

SEA MILKWORT

The Sea Milkwort (*Glaux maritima*), or Black Saltwort, as it is sometimes called, is a little, low-growing plant, very common on sandy and muddy shores and in salt marshes. It is a pretty plant, and is well worth the risk of wet feet to find it. There is no relationship, except in name, between it and the Milkwort of our heathy ground, and very likely few would place it, on first sight, in the family of the Primroses (*Primulaceæ*). The Sea Milkwort seldom grows more than five or six inches in height; it is a humble little flower, and prefers rather to creep along the ground; the tiny rose-coloured flowers are produced in the axils of the leaves. There are no petals, the sepals being coloured instead, and appearing to be a corolla.

SCURVY GRASS

Flowering throughout the summer from May to September, the Scurvy Grass (*Cochlearia officinalis*) is not uncommonly to be found growing on the muddy shores by the sea. It is more common

in Scotland than in England or Ireland; it does not often grow very large, seldom exceeding six inches in height. The whole plant is smooth and, as is generally the case with flowers growing in like localities,



SCURVY GRASS.



THRIFT.

somewhat fleshy. The leaves that spring from the roots are all stalked, kidney shaped, and deeply heart-shaped at the base. Those growing on the stem are for the most part sessile; the base clasps the stem, and the whole leaf assumes a rather angular shape with a few large teeth. The flowers are above half an inch across, white, with sometimes a dash of purple.

Many explorers have found the Scurvy Grass to be of very great use in keeping off and curing scurvy; the plant holds in its tissues an oil with a bitter taste, which has proved to be a good remedy for the disease. Probably any other green food, if it had been available, would have been just as efficacious. The name

Cochlearia comes from the Latin word for a spoon, and refers to the shape of the leaves.

THRIFT

The Thrift, which was formerly known officially as *Armeria vulgaris*, but is now called *Statice maritima*, is a well-known plant in gardens, being frequently used for making an edging—and a very good one it makes when the soil suits it. Prior, in his book on the origin of plant names, states that the popular name is part of the old verb *threave*, or *thrive*, to press close together, and refers to the dense tufts which the plants make. The Thrift is a member of the Plumbago family, of which this plant and the Sea Lavenders are the only British representatives. Pliny mentions it under the name of *Statice*, which is derived from the Greek words signifying *to stop*, as this plant, by growing in sandy situations, is found to retain and stop the movement of the sands. In the time of Queen Elizabeth it was called "Ladies' Cushion" and Sea Gilloflower, and now it is often termed the Sea Pink. The leaves are all narrow, and have a prominent midrib. They

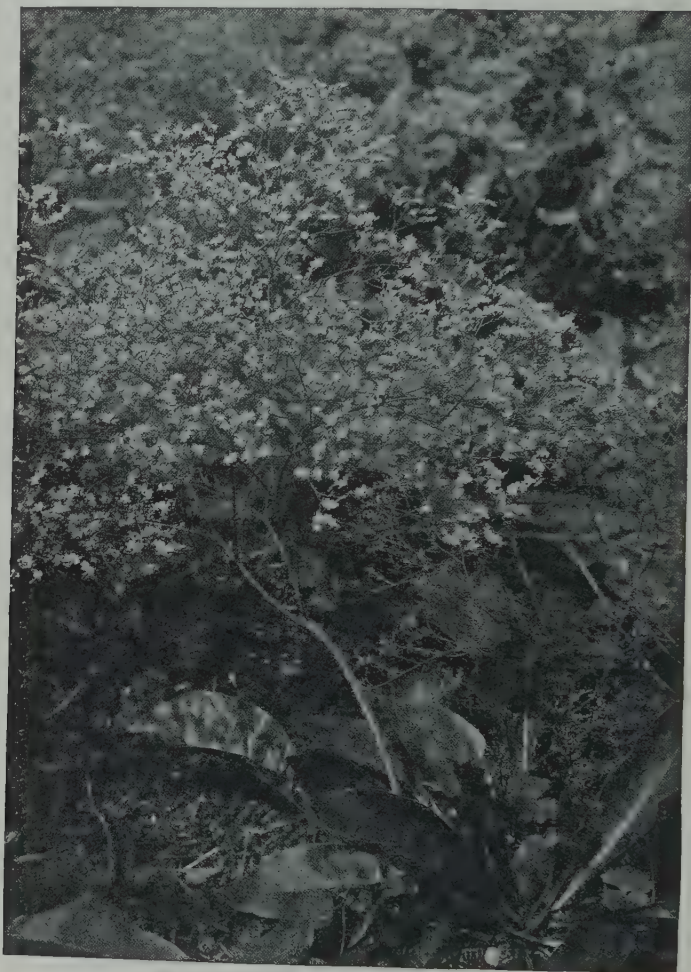
form a thick rosette on the ground. The flowering stems grow from three to six inches high, and each one bears a globular head of pink flowers. The colour is somewhat variable, and may be found as deep rose or white.

The Thrift is to be seen growing in most seaside places, either on the shores or rocks, and also on the higher pastures. It is found, too, on the tops of some of the Scottish mountains. When growing in a mass, and when in full bloom in summer, the pink tinge of colour is very effective. Another species, *Statice plantaginea*, with broader leaves, each one with three or five nerves running up them in a parallel direction and with a taller flowering stem, is to be found in the Channel Islands.

SEA LAVENDER

The Sea Lavender (*Limonium vulgare*) belongs to the same family as the Thrift, and it formerly used to bear the name of *Statice* when the Thrift was called *Armeria*. Most people will know this plant, or some of its congeners; many of them are grown

stalked and vary very much in size, attaining a length sometimes of nearly a foot, they vary also in width, some being narrow and others broad. The forked flower stem rises erect from the root and is generally much branched. The flowers are very numerous, of a

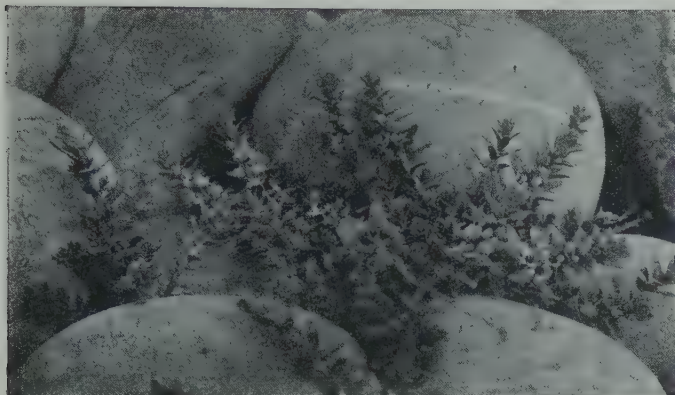


SEA LAVENDER.

in gardens, and form a welcome addition to the flower borders because of the lavender tint of the heads of flowers. These are of a dry nature, and consequently retain their form and colour for many months, and help to decorate the winter bouquets.

The rootstock is sometimes very thick, and rather fleshy; the leaves are all

bluish purple colour. The upper part of the calyx is also tinted with purple, and after the blossoms have been out for some little time, the calyx expands and becomes enlarged, so that it may be mistaken for the true corolla. The Sea Lavender flowers during July and August. The flowering period would seem to be longer because of the peculiarity just



SEA MILKWORT.

ported on the top of the leaf-stalks. The flower stems grow sometimes nearly a foot high, and bear a long succession of pendant, yellowish-green blossoms. The succulent nature of the plant proclaims it at once to be a member of the Sedum or Stonecrop family (*Crassulaceæ*). It seems to enjoy growing amongst rocks and on old walls, and flowers from June to September.

mentioned; it is one of the handsomest of our maritime plants, and should be looked for on muddy and sandy shores and in the salt marshes.

KIDNEY VETCH

The Kidney Vetch, or "Lady's Fingers" (*Anthyllis vulneraria*), is one of the Leguminous family; it is included here because it grows in great abundance on the cliffs and in the pastures near the sea; but it is also very common inland. The dense heads of flowers are generally in pairs (at the top of the stem). The blossoms are either yellow or reddish; the colour seems to depend very much on the soil in which the plants are growing. The calyx is inflated and very hairy, as indeed is the whole of the plant; it is this soft, inflated calyx that is the origin of the name "Lady's Fingers," as several of them together are supposed to resemble gloved fingers.

PENNYWORT

Those who have been along the south coasts will have probably come across the Pennywort or Navelwort (*Cotyledon umbilicus*), with its round, fleshy leaves sup-



PENNYWORT.

ABOUT THE JACKDAW

By BENJAMIN HANLEY

With a Photograph by the Author

IN the flocks of rooks flying overhead, particularly during the winter months, numbers of smaller birds will be noticed which have a much quicker flight than the rooks, and every now and again they give vent to a cry something like "chack-chack" or "jack-jack." These are Jackdaws, which consort a great deal with rooks at their feeding grounds. When close at hand it will be seen that there are many points of difference apart from size; the Jackdaw has the face fully feathered and a much shorter beak. The crown is deep

velvety black, and in the adult the neck is grey and the eye pearly white; these contrast with the otherwise dull black plumage.

Like the rook, the Jackdaw builds a nest of sticks, but unlike that bird it is placed out of sight in the hollow branch of some tree, an old church tower, or hole in the side of a cliff.

If undisturbed the birds return year by year to the same nesting haunt, and each season add considerably to the materials used for nest building, so that in the course of time almost a cartload

of rubbish may be collected. The eggs, sea green with many black spots, are usually five in number. The young make interesting pets, and if taken before they leave the nest become very tame, so

that there is no need to pinion their wings or confine them in any way. It should be added, however, that they learn many mischievous tricks, until in some cases the owner is either obliged to give them away or keep them in captivity.

I know of one case where the bird had a fondness for collecting and hiding bright things in the thatch of a

cottage. This was tolerated so long as it took nothing of greater value than safety pins or such-like objects, but when it began to make off with silver coins, and not confine its depredations to its owner's property, some restraint had to be put upon it.

They learn to repeat certain words quite easily. At one time a belief was prevalent that to make them talk properly the tongue should be cut with the edge of a sixpence. Such a cruel method is, of course, absolutely useless as far as assisting the bird to talk is concerned.



THE JACKDAW



LEAVES AND FRUITS OF COMMON BUCKTHORN.

HOW TO KNOW THE SHRUBS GROWING IN BRITAIN—II

With Notes, descriptive and photographic, for their Identification
in all Seasons of the Year

By HENRY IRVING

THE SPINDLE-TREE AND THE BUCKTHORNS

THE Spindle-tree, as its name indicates, may attain to the distinction of a small tree, but its usual habit is that of a shrub merely. Its name dates back to the time of the universal spinning-wheel, when its wood was chiefly utilised in the manufacture of spindles. For the greater part of the year it claims little attention, being generally mistaken, through casual observation, for the more familiar Privet. But with the coming of autumn there can be no such lack of regard. With the fading of the leaves the

handsome four-chambered fruit takes on its special colouring of rosy pink, deepening and brightening as the leaves fall away till the bush is all aglow, conspicuous from afar.

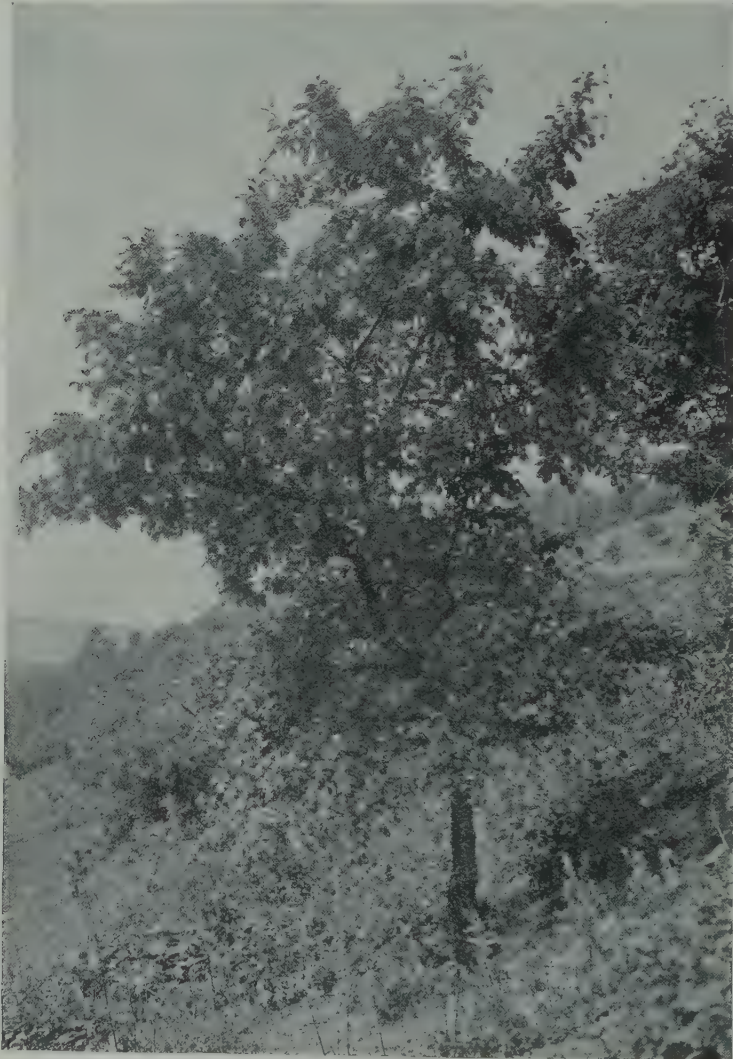
One of the pleasantest surprises, with the increasing greyness of the shortening days, is to come suddenly upon a Spindle-tree, leafless, but crowded with what might seem to be an array of lovely waxen flowers. This fancy is only more assured by closer inspection. Each fruit hangs gracefully suspended by a slender stalk, and the

four opened cell-walls may readily be likened to expanded petals; whilst the enclosed seeds, now exposed to view, accentuate the floral resemblance with their vivid orange colouring—"The fruit which in our winter woodlands looks a flower."

The twigs are matt green in colour, and so remain for several years. Indeed, even upon the main stems lines of green show faintly through the prevailing grey. Four slender ridges, running lengthways along the twig, give to it a four-angled appear-

ance. The small buds, arranged in opposite pairs, are oval, pointed, and protected with scales. The leaves are a long oval, but taper to a point, both at the base and tip. They have one main rib, from which branch off about eight pairs of secondary ribs. These are slender, and curve forward, looping one into another near the leaf margin. The margin is finely toothed.

The flowers, which are in small branched clusters, spring from the points of junction of the leaf-stalks and the shoots. Individually, they are small and incon-



BUCKTHORN GROWING AS SMALL TREE.

spicuous. They have four greenish-white petals, projecting in the form of a cross from the margin of a fleshy, central disc. Four stamens stand erect upon this disc, alternating with the petals, and in the centre of all is the pistil. Nectar lies exposed upon the disc. The insect visitors are chiefly flies. The fruit is, as already indicated, a four-celled capsule, rosy pink in colour, which splits open lengthways of each cell, exposing one or two orange-coloured globular bodies in each. These are the seeds, in pulpy coating, rendered thereby attractive. They are eagerly extracted by blackbirds and thrushes, but are poisonous to man.

THE BUCKTHORNS

There are two of these. In general character they are much alike, but a closer scrutiny shows many and well-defined differences. Both may become small trees, but they are usually met with as shrubs. They are the Common Buckthorn, also spoken of as the Purging Buckthorn; and the Alder Buckthorn, or Breaking Buckthorn. The name Buckthorn is but an Anglicised misspelling of the German "Buxdorn," which is Box thorn, or thorny Box.

The Common Buckthorn has a preference for a chalky or limestone soil. It possesses thorns, and for this reason, in the leafless condition, may be mistaken casually for the common Sloe, or Blackthorn. The appearance and arrangement of the buds will at once serve to distinguish these two. Those of the Blackthorn are rounded and blunt, frequently occur in clusters, and are arranged spirally upon the twig. The buds of the Common Buckthorn are long and pointed, pressed up against the twig, on which they are arranged in nearly opposite pairs, having this peculiarity that they seem as though they had been slightly pushed out of position. They are dark brown in colour, and are protected by scales. A thorn fre-

quently appears at the end of the shoot, projecting between two tightly-pressing buds. When these buds grow out into shoots, one on either side, the thorn remains standing in the fork which results.

The leaves are a broad oval, rounded at the base, with a supplementary point attached at the apex. Three pairs of secondary ribs branch out from the midrib, but from the lower half of it only. These all curve forward, converging towards the apex in a manner similar to those of the Dogwood. The margin is very finely serrated. The flowers, which grow in tufts at the base of the young shoots, have four very minute greenish petals. Pollen-bearing flowers here are distinct from those producing fruit, and these, as a rule, appear on different shrubs. Some shrubs, in consequence, yield no autumn fruit. The fruits are bunched at the base of the current year's shoots. They are



LEAVES AND FLOWERS OF ALDER BUCKTHORN.



1. TWIG WITH SPINES OF
COMMON BUCKTHORN.
2. TWIG OF SPINDLE.



globular, black in colour, and possess, each of them, four stones.

The Alder Buckthorn is not very happily named, since it has little, if anything, in common with the Alder beyond the fact that it chooses a moist soil to grow in. It is generally found on clay or loam, rather than on chalk. The buds are small, and without scales, being protected by narrow, downy stipules, which give them a grey appearance. The twigs are downy at the tips, and are usually violet-brown in colour. There are no thorns. The arrangement of the buds shows a remarkable variation. In the central portion of the twig the buds distinctly alternate, whilst below and above they stand nearly in opposite pairs.

The leaves, somewhat thin and smooth in texture, and of a paler colour on the under surface, are of similar shape to those of the Common Buckthorn, but the venation is distinct. About eight pairs of secondaries branch out from the mid-rib at points about equally distant, and along its whole length. These secondary ribs are straight and parallel till nearing the margin, when they



FRUITS OF SPINDLE.

loop one into another. The leaf margin is quite without teeth. The flowers, growing in smaller groups at the points of junction between the leaf-stalks and the shoot, are consequently disposed more or less along its whole length. Each has five small white petals, and is complete, possessing both stamens and pistil, so that here there is no distinction of a fruiting and non-fruiting shrub. Flies, again, are the chief visitors. The fruits, rather larger and less bunched, are also globular, and black in colour when ripe. Each contains two (or three) stones.

The presence in the spring, and again in the autumn, of a Brimstone Butterfly is generally a safe indication of the near neighbourhood of Buckthorn, this shrub providing the foodstuff of the Brimstone's caterpillars.

The Sea Buckthorn, allied in name only, is of local occurrence. Its leaves are willow-like. Its fruits are yellow berries.



LEAVES OF SPINDLE.



FOUR DRONE FLIES WITH A HIVE BEE IN CENTRE.

THE FLY AND ITS HABITS

By R. A. STAIG

Illustrated from Original Photographs by JOHN A. BALLANTYNE

FLIES have never been favourites. Innate, or accidental, the tiresome ways of the few have earned opprobrium for the whole order; and so it has come about that the two-winged Fly is commonly regarded rather with aversion than with interest.

Like other living things, it arises from an egg—not straightway becoming the perfect winged form, but gradually, by a wonderful creative process of transformation, evolving through two transitional beings, both dissimilar, and neither the one nor the other superficially suggestive of the future Fly.

Very small and seldom seen are the eggs of the Common House Fly; unconsidered trifles, much too minute for average eyesight and rarely found in pleasing places. Were it easy to look within these sculptured spindles we would see the most delicate imaginable streak

of living matter in a state of ceaseless activity, building up a body; the astonishing formation of a maggot from a mere speck of that marvellous vital substance, protoplasm—and within less than thirty-six hours. Living amid ugliness and in obscurity, a strange creation is the white maggot—a limbless object with a tapering, mobile “neck,” almost headless, but possessing a mouth; well adapted for the particular business of its brief existence, to consume the refuse where it was born. Five or six days is the duration of this larval state, then it becomes quiescent and undergoes phenomenal change. Every structure internal is broken down completely. That which was the maggot seems to be again an egg, for within the skin capsule filled with the creamy products of destruction nothing remains of the original organisation save some remnants; but out of these, and from



THE CLEG, OR STOUT (*HÆMATOPOTA*),
(Magnified two diameters.)

the reconstruction of the living débris, is formed the nymph or pupa which, six or seven days after the passing of the maggot, emerges as *Musca domestica*.

Thus within three weeks during the warmer months of the year any one Fly female may give rise to no fewer than one hundred or one hundred and fifty individuals, for such is her egg-laying capacity.

A feature of the Fly is its face—merely a depressed vertical strip between the two great eyes which are close together, and which, being wide in extent, enable the Fly without moving to see in front, below, and above, somewhat sideways, also fairly well round a corner. Slight magnification shows the numerous facets forming the eye surface; but with the aid of the microscope it is found that each one is the outer portion of an underlying lens, and the astonishing discovery is thus made that what at first sight seemed a large single eye is actually a combina-

tion of four thousand or more massed together to function as one.

Watch a House Fly settle anywhere, and it will presently begin dabbling with its long cushion-tipped trunk, selecting tasty motes invisible to the human eye, and quite likely, at the same time, innocently transferring equally invisible but highly noxious germs casually carried from some recent place of call. The lips, tongue, and other mouth-parts have all been utilised to form this useful instru-

ment by means of which the Fly takes, or rather siphons, up its food, and with which it can explore where it could not possibly put its head.

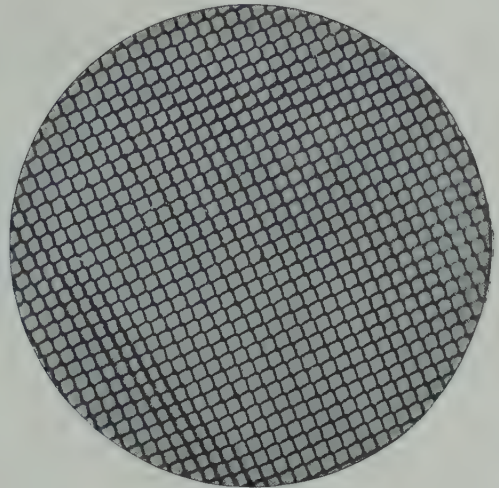
For long it was a mystery how the Fly, "turning gravity to jest," walks and runs so easily along a ceiling, or up and down a perpendicular piece of glass. The two pyriform pads beneath the terminal claws of each foot were supposed to act like suckers when applied to polished surfaces; but a closer inspection of the pads revealed the



TRUNK OR PROBOSCIS OF FLY.
(Magnified.)



EGGS OF THE HOUSE FLY.
(Magnified twelve diameters.)



SURFACE OF A FLY'S EYE SHOWING FACETS.
(Magnified.)

interesting fact that the closely set hairs on their under surfaces secrete the stickiness which secures the Fly's footing.

When a Fly is not busy dabbing something, most likely it is stroking its head, or cleaning its wings, or rubbing its "hands" or its "feet" briskly together. Its inquisitorial pursuits evidently necessitate a prodigious amount of personal cleansing, for which purpose the inner side of the middle portion of the leg, being densely hirsute, is used as a brush.

Recently, along with others, the domestic Fly was found guilty of spreading infection by transporting harmful microbes upon its hairs. It has also been accused of desultory biting, particularly during the autumn months; but investigation shows that the Flies frequenting houses are not invariably all true House Flies, however similar they may seem to be. Two which are often found indoors are *Homalomyia* and that market garden pest, the Cabbage Root Fly



FOOT OF FLY, SHOWING THE PYRIFORM PADS
BENEATH THE CLAWS.

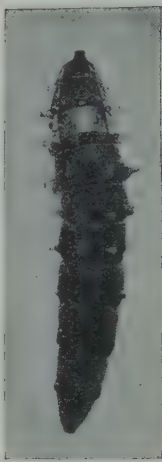


HEAD OF A TABANID MAGNIFIED TO SHOW
THE TONGUE AND LANCETS.

(*Anthomyia*). These are mis-called "Small House Flies."

There is a third, the Storm Stomoxys, and this is the culprit whose wickedness has been charged against the unfortunate House Fly. It will be seen from the photograph that in size and in outward appearance the biting Stomoxys closely resembles the four House Flies in natural attitudes around it; but its trunk is very different—a rigid needle-piercing proboscis carried, as shown, projecting horizontally in front of the head when not in use. Its customary haunt is the pasture field, where it may often be noticed resting on the gates. Strangely enough, it has a habit of entering dwellings before the approach of a storm, leaving when the weather brightens. Stomoxys reminds one of the dreaded tropical Tsetse (*Glossina*). The inexperienced might see no difference between them. Not entirely sanguinivorous, it is frequently found sucking up nectar from flowers.

A giant of the race is the Horse Fly



AQUATIC LARVA
OF A TABANID.

(*Tabanus bovinus*), a phlebotomist whose lancets can penetrate an ox hide. When flying, the vibration of its powerful wings produces a strong humming sound, terrifying to grazing animals. The females are the afflictors. The imperfect lancing apparatus of the males renders that sex incapable of blood-sucking. While the females are busy with the cattle in the meadows, the males are elsewhere engaged with the flowers. For the same reason the males of other biting Flies, with few exceptions, subsist on the juices of plants. This is true of *Hematopota*, the provoking Cleg, a lesser relative of the dun and bulky Horse Fly. In the hot

sultry days it is scarcely possible to walk in the vicinity of woods without experiencing this paragon of viciousness. How silently she settles—no intimation of her presence until the first pungent prick! It is difficult to think of anything more exasperating, more productive of unseasonable temper, than the calmly insistent way in which these deliberate



THE CENTRE OBJECT IS STOMOXYS, THE OTHERS ARE HOUSE FLIES.



THE FOREST FLY (*HIPPOBOSCA EQUINA*).
(Four times the natural size.)

Clegs devote themselves to one's person. Myriads of these green-eyed termagants, but not a male among them!

The formidable nature of the Tabanid mouth instruments will be seen from the photograph on page 887. The lip and tongue combined forms the sucking proboscis, here placed close against the side of the head. The other spread-out parts are sharp stylets and cutting blades. When operating upon a victim, the Tabanid applies its proboscis firmly to the chosen spot and sucks up the blood from the wound made and widened by using together the stylets and blades.

Tabanidæ deposit their dark-hued eggs upon grass or rushes in marshy places or by the water's edge. The maggots, or larvæ, are whitish and cylindrical, tapering at the ends, and with rings of fleshy protuberances encircling the body. Some

are entirely aquatic, living among the mud of ditches or under stones in rapid flowing streams. They are carnivorous, devouring snails, worms, and water-beetle grubs.



"RAT-TAILED MAGGOT" OF THE DRONE FLY
(*ERISTALIS*)

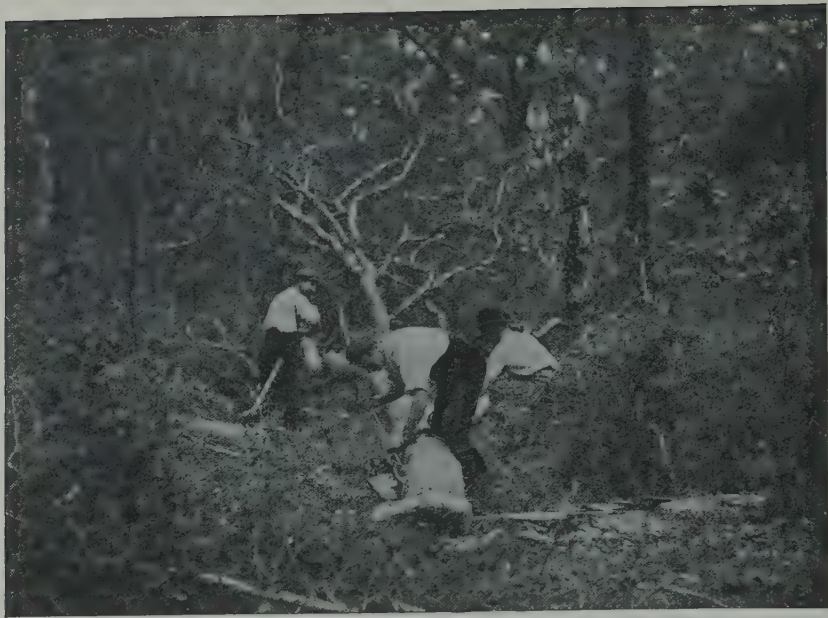
And first and second pupal stages.

Seeing a "rat-tailed maggot" brought forth from a stagnant puddle, anyone unacquainted with the strange vicissitudes of insect life might find it difficult to believe that so odd-looking a creature is in reality a Fly in making. It appears in early autumn as the Drone Fly (*Eristalis*), leisurely moving over sunflowers and thistles and flying suddenly from bloom to bloom. At a short distance it looks so like a hive bee in size, form, and colour that it may readily be mistaken for one.

R. A. STAIG.



THE HORSE FLY (*TABANUS BOVINUS*).
(Magnified half a diameter.)



STRIPPING THE BARK FROM AN OAK TREE IN THE NEW FOREST.

LIFE IN THE NEW FOREST—I

By F. MARTIN DUNCAN, F.R.P.S.

Illustrated with Photographs by the Author

THE New Forest! What recollections of feudal England its name brings to mind! Although called the New Forest, it is probably one of the oldest forests in England. Even to-day it holds many specimens of timber which date back beyond the time of the Roman Conquest.

The Forest embraces in its entirety considerably over 92,000 acres. Of this there are 62,746 acres over which one may wander without let or hindrance. Here and there, we may come upon a fenced area which is kept as a sanctuary and resting-place for some of the wild creatures, which but for these small reservations would inevitably disappear.

It is a great misfortune that the whole of the Forest is not appropriated as a national reservation for the protection of

the many birds, beasts, insects and plants which are all too rapidly becoming extinct, thanks to the depredations of the professional collector. During the last few years the professional collectors who frequent the Forest, and make their living by collecting and selling caterpillars, butterflies, birds' eggs, etc., have increased in number and in activity; and it is inevitable that unless some measures are taken to put a stop to the present wholesale collecting of the rarer insects, plants and birds' eggs, the Forest will soon become denuded.

The wide area of the Forest presents such unique features of varying environment that nearly all creatures and plants to be found in Great Britain might make a home within its confines.

Passing through the Forest glades on a

late spring morning, the ringing sound of the axe falls upon one's ear, and a turn in the drive discloses one of the foresters busy lopping the branches of a recently felled tree.

One of the most picturesque Forest industries is that of felling the young oak trees in the spring, for the purpose, chiefly, of collecting the bark, which ultimately finds its way to the tanyards. It is looked forward to by the foresters with a good deal of pleasure, because it yields them a small extra royalty on their ordinary wages, and it is a pleasant sight to see with what a will the sturdy fellows engage in their work.

The moment the tree is felled to the ground some of the men set to work to lop off the branches, while others, with the aid of their barking irons, begin to strip the bark from the trunk and larger limbs.

While the barking is proceeding, one of the foresters may be seen rapidly constructing a frame with the smaller branches at a little distance from the tree; and against, and upon, this frame the bark is placed to dry. The length of this process is determined by climatic conditions, but if the spring be a genial one, the bark

remains on the drying screens for about ten days.

When the bark is ready to be sent to the tanyards, the foresters go through the drives with their carts to collect it. The bark is gathered into bundles, and each bundle is weighed before being placed on the cart. When the carts have been filled they rumble away through the Forest glades to the nearest railway station, and from thence the bark finds its way all over England into those tanyards which make a speciality of oak bark tanning.

Towards the close of the summer, and during the autumn, the heavy lumbering waggon may be seen passing down the roads, laden with the trunks of the trees from which the bark had been stripped in the spring, on their way to the sawmills.

The people of the New Forest are a sturdy, self-reliant race; the Saxon strain remaining strong in them, and one finds them still using old Saxon terms.

Curiously enough, although one would imagine such an environment as the New Forest, with its deep, silent woods and large tracts of lonely, marshy moorland,



WEIGHING AND CARTING THE OAK BARK.

an ideal one for the birth of folk lore, yet the Forest is singularly poor in legend.

Frequenting the Forest as I have for many years, photographing its inhabitants, human and otherwise, I have been unable to find anything of great remark in the nature of legend or superstition. I remember well on one occasion asking an ancient inhabitant if he had ever heard of any ghost story or legend connected with the Forest. After some little thought he replied, "He didn't think he had ever heard tell of any ghosts being seen about. He did remember that his grandfather used to go up on to Beaulieu Heath to look at the skeleton of a highwayman hanging in chains, in the skull of which some tom-tits had built their nests."

A very remarkable character of the Forest passed away about three years ago in old Brusher Mills, who for many years had picked up a living as a snake catcher. At one time he made a fairly good living by this curious trade, supplying the Zoological Gardens and dealers with grass snakes and adders.

For many years he lived in a rude hut that he had built for himself in the Forest, and it was a very sore point with old Brusher that the verderers turned him out of his hut and destroyed it. It was a necessary act, however, because the old man had remained on the site so long that it was almost approaching the time when he could have claimed squatter's rights.

The Verderer's Court, in which all offences against the Forest laws are tried, is called the Court of Swain Mote; a name which, according to Manwood, is derived from the old Saxon word "mote," equivalent to the Norman "court," and the familiar "swain," or freeholder.

The foresters are permitted to turn out to graze in the Forest a certain number of ponies and cattle; they also have rights to cut turf which is used for fuel; and those foresters who hold the full commoner's rights are permitted to turn out their pigs in the legal "ovesting" or "pawnage" months, when the acorns and beech mast have fallen to the ground; that is, from about September 25th to November 22nd.

One of the most typical sights in the New Forest during the early summer is that of the half-wild ponies and their

foals. During the daytime, in the summer, the ponies frequent the open land, where there is generally a gentle breeze blowing which helps to keep away the irritating flies, and it is a pretty sight to see the foals at play, chasing each other across the lawns and frolicking in the warm summer sunlight.

As evening approaches the mares whinny to their foals, and generally draw off towards the Forest glades, seeking shelter and warmth in the denser foliage during the night.

One of the most remarkable things about these ponies, to my mind, is their knowledge of the treacherous marshlands. Here and there, scattered over the Forest, we come upon areas of marshy, quaking bog, where one has to pick one's footsteps with considerable caution. The quaking bogs are areas of soft spongy land that tremble beneath your footsteps, and where you have to walk circumspectly, for a false step means an immersion in the bog, or possibly even one's total disappearance beneath the surface.

Now when wandering out across the bog-land studying and examining the plants peculiar to that environment, or observing the birds that frequent these lonely wastes, one remarks at once the tracks of the Forest ponies; and so long as one follows in their footsteps there is little fear of going through the surface of the bog to a greater depth than, perhaps, over one's ankles. It is wonderful the way in which these paths twist and turn through the bog; the ponies, apparently by some instinct, knowing exactly how far they may venture out on these treacherous, quaking lands. The result is that, unless driven frantic by fear, they travel across the bog-land without any mishap; and, indeed, it is a very rare occurrence for a Forest pony to founder in the marsh.

Returning home one evening through the Forest, I came upon a curious friendship existing between a hen and a cow belonging to one of the foresters. The cow was turned out of her byre every morning and wandered off into the Forest accompanied by this white hen. When the hen grew tired she would fly up on to the back of the cow and sit down comfortably and calmly and have a ride. I found that there was a good deal of give

and take really about this friendship, for when the cow grew weary in the noon-tide heat, and settled herself down for a quiet siesta, the hen would then mount guard and employ herself in picking off the flies that settled on the nose and round the eyes of the cow.

The naturalist in his rambles through the Forest will probably come, sooner or

observation of the wild creatures of the Forest.

Unfortunately, there are within the boundaries of the Forest a number of would-be gipsies who have no right to that name; they are mostly lazy, drunken, unclean tramps, too lazy to earn an honest living, content to shift from pillar to post, picking up a precarious living by what



FELLING A YOUNG OAK IN THE FOREST.

later, upon a gipsy encampment. There are still wandering in the Forest district two or three families of true gipsies, who speak the old Romany language, and who are true children of Nature, loving their outdoor life; and having a keen knowledge of the birds and beasts around them, the naturalist photographer will often find the gipsies a considerable aid to him in his work.

Gipsies are suspicious of strangers, fearing alike the possibility of a police spy or someone connected with the educational authorities, and therefore it takes a little time to become on friendly terms with them; but once the friendship is made, they are only too willing to help anyone who is really interested in nature, in the

they may beg or steal; and, unfortunately, it is from the depredations of these people that the true gipsy has gained a bad name.

Amongst the gipsies one finds a certain amount of folk lore and legend relating to the Forest. They are a more romantic people than the Saxon inhabitants, and many a strange and weird story is recounted round the encampment fire at night.

To the lover of wild nature I know of no more delightful place to spend a holiday than the New Forest. In spite of the depredations of the professional collector, it still offers a unique ground for the observation of many of the rarer species of insects, birds, animals and plants.

Here one may see, if the season is a good one, the White Admiral butterfly actually in profusion. It is no uncommon sight on a warm summer's morning to see as many as fifteen or twenty of these magnificent butterflies flying over the opening blossoms of the honeysuckle and blackberry. How much longer they will remain plentiful it is difficult to say, unless public interest can be sufficiently awakened, and a strong demand be made for the more strict preservation of the Forest.

In the spring of the year the drives are beautiful with the blossom of the early orchid (*Orchis Masculula*), which depends for the transference of its pollen upon

the visits of insects, and gains the benefit of cross-fertilisation through their agency.

An hour or two on a sunny spring morning may be spent with considerable profit to the lover of nature in watching the insects which visit the opening blossoms of this plant. The principal insect visitors, to these orchids growing in the Forest glades, will be found to be various species of bees, and it is a most interesting sight to see a bee alight upon the lip of an orchid flower and thrust its head inwards, in search of the drop of nectar which lies within the spur at the base of the sepals of the flower. As the bee thrusts her head inwards to suck the honey, she



AN ANCIENT MONARCH OF THE FOREST: THE KNIGHTWOOD OAK.

brings her forehead against the two little pollen masses which, if ready for transference, are very sticky at their base, and when she withdraws her head she carries them away. As she climbs up to the next flower, or round the spike, perhaps from one flower to another, we are able to see the two tiny pollen masses standing upon her forehead. The drying action of the air causes these pollen masses in a very few minutes to bend forward, so that when the bee alights upon another orchid flower and thrusts her head inwards to sip the nectar, the pollen masses have assumed such a position on the insect's head that they come into contact with the viscid surface of the stigma, and, in this way, the pollen is taken by the bee from one flower and transferred to the stigma of another.

While watching and photographing the bees at work amongst the orchid blooms in a Forest drive, I observed a most interesting example of protective colouring. A bee had thrust its head into a flower and was busily engaged in sucking up the nectar, when suddenly something, that from a short distance looked like one of the unopened flower buds of the orchid, fell from the top of the flower spike upon the insect's back. The bee gave a shrill buzz of alarm and struggled to free itself from this apparent bud, which, in reality, was a spider. The foe was too strong, however, and having overcome the bee, carried it down to the base of the flower spike, and under the shelter of the drooping and half-withered blossoms, feasted upon the juices of its victim.

The spider having finished its meal, dropped the bee, and once more ascending the flower spike, tucked itself away amongst the round unopened buds, from which it was practically impossible to

distinguish it, so closely did the shape of its body and its coloration resemble one of the unopened buds.

The lordly Purple Emperor butterfly is fairly common in the Forest, and may be seen flying over the topmost branches of the oak trees. Although such a magnificent insect, his tastes are somewhat plebeian, and his habit of frequenting the nearest pig-sty often leads him to disaster, for while engaged in feasting in this unsavoury spot he falls an easy victim to the ardent entomologist.

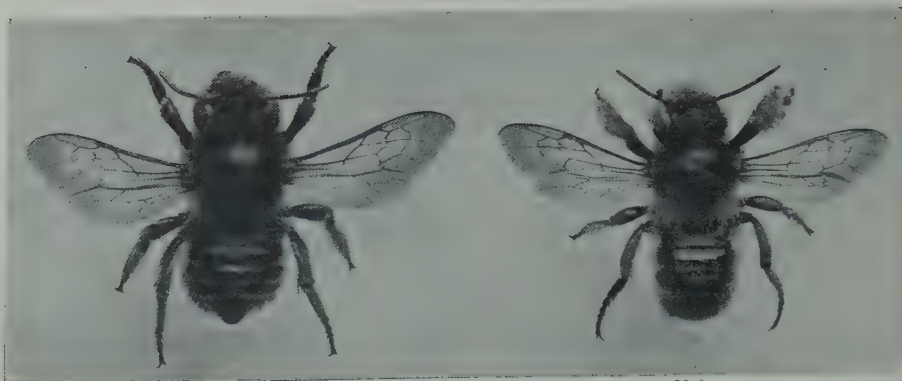
In late spring and early summer, as the dusk approaches, the trilling, sibilant note of the Mole Cricket sounds through the Forest glades, particularly where a rivulet flows by sandy banks, and if you watch carefully, you may see one of these curious insects come to the surface of the ground and perhaps take flight. The insect has gained its popular name partly from the subterranean life it leads, partly from a curious resemblance of its front pair of legs to the front legs of the mole. The muscular power of these short, broad legs of the Mole Cricket is very great, and it is a most interesting sight to see with what rapidity the insect burrows into the soil when alarmed.

One of the strangest insect inhabitants of the Forest is the caterpillar of the Lobster Moth (*Stauropis Fagi*). It lives, in July and August, on the beech, oak, alder, birch, hazel and lime, and has gained its popular name from the curious shape of the last two segments of its body, which somewhat resemble a lobster's claw. These caterpillars are nearly always to be met with singly, and seem to be of a curiously quarrelsome disposition, for should two meet upon a branch, a fight almost always ensues; while if two caterpillars be kept in the same cage in confinement, they will certainly fight and probably kill each other.

F. MARTIN DUNCAN.



HUMBLE-BEE VISITING EARLY ORCHID.



Female. LEAF-CUTTING BEE (MAGNIFIED). Male.

THE LEAF-CUTTING BEE

By HAROLD BASTIN

With Photographs by the Author

THE genus *Megachile* (Leaf-cutting Bees) comprises seven British species. All of them are specially interesting in their habits. One or two of the species are quite common, and the reader should have no difficulty in verifying the statements which I am about to make. The particular Leaf-cutting Bee shown in the accompanying photograph is called *Megachile willughbiella*. It often frequents gardens, both in the country as well as in London suburbs. In appearance it bears a distinct likeness to the Honey Bee, but is stouter and more thick-set. The male has its anterior foot-joints, or tarsi (excepting the terminal one), beset with a dense fringe of hairs—for what reason I have never been able to discover. But, as is the case with many other insects, the male Bee is a lazy fellow, whose habits call for no special remark.

Let us turn then to the female. She is larger, and considerably more robust than her partner; and this is as it should be, for her life is passed in a round of arduous labour. Should you wish to discover whether the Leaf-cutting Bee is at work in your garden, you need only

examine the leaves of the rose bushes. If any of these have cuts in them—some oblong, others almost circular—you may be sure that the insect is not far off, for the cuts in the leaves are her doing. She has been gathering material for cell-making. Come again to the rose bush during the morning hours, when the hot sun shines upon it, and you are almost certain to find the Bee busily engaged. Suddenly she alights upon a leaf, grasping with her legs the piece which she desires to cut away. Then, with her jaws she rapidly cuts the leaf-tissue; and just as one imagines that she has bitten away the last shred of her support and will fall to the ground, she puts her shining wings in motion and darts off, carrying the severed piece of leaf safely gripped beneath her body. And whither does she go? So rapid is her flight that it is difficult to follow its course with the eye. But by the exercise of a little patience, her destination may be discovered. This, when found, will prove to be a small tunnel leading to the interior of some decayed woodwork, such as a gatepost, or a beam in an outhouse or shed. For the reader must know that the Bee's

labours do not begin with leaf-cutting. She has, so to speak, several trades at her command, and at first she plays carpenter. Having found a beam or post a part of which is sufficiently decayed for her purpose, she drives a tunnel into it—rasping at the wood with her jaws, raking the chips beneath her body by means of her legs, and then, by walking backwards, pushing the débris out of the hole.

this piece rapidly—never, as far as I have seen, making mistakes. First of all the lozenge-shaped pieces are cut and carried one by one into the tunnel, and trodden into place until a thimble-shaped cell is formed. Then the Bee abandons leaf-cutting for a time, and resorts to the flowers, from which she gathers a supply of nectar and pollen. From these ingredients she compounds a sweet paste—



ROSE LEAVES CUT BY LEAF-CUTTING BEE.

The Leaf-cutting Bee will toil for days in her tunnel. At length, when she has made it long enough to suit her purpose, she abandons carpentering and begins to cut leaves. How she does this we have already seen. She uses the pieces of rose leaf to form cells, within each of which she deposits an egg and a supply of food for the young grub which will hatch in due course.

The pieces of leaf have to be of several shapes in order to build up the cell, but they may be roughly classified into lozenge-shaped pieces and circular pieces. The Bee's instinct seems to tell her exactly what pieces are needed when a certain stage of her work is reached, and she cuts

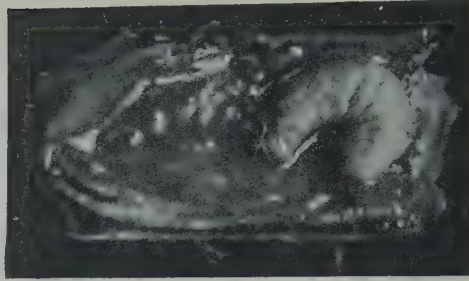
ultimately more than half filling the cell with it. She then lays one egg in the cell. Finally, she again resorts to the rose bush and cuts some circular pieces of leaf, by means of which she closes the cell's entrance. When one cell is completed, the industrious Bee proceeds at once to form another, and so on until the tunnel is almost filled, the last inch or so being plugged with wood chips.

The number of leaf-fragments employed by the Bee in the formation of each cell varies somewhat with circumstances, but normally there are seven lozenge-shaped and four circular pieces. In the photograph on page 899 the reader may see the Bee side by side with its eleven pieces

of leaf, and may thus form some idea of the amount of labour compassed by the insect; but it should be remembered that to the labour of leaf-cutting must be added that of tunnelling and of gathering provisions for each cell as it is made. I

do not think that it is possible to estimate the average number of cells formed by each Bee in the course of the season, for the reason that when one tunnel has been filled the insect may, and sometimes unquestionably does, make and fill another tunnel. I am convinced, however, that a score or more cells must often be made by a single Bee.

A photograph reproduced on this page shows us part of a decayed beam (taken from a greenhouse) from which one side has been carefully removed, showing in section two of the Bee's tunnels with leaf-cells *in situ*. The egg in each cell hatches in a few days after it is laid, and the young grub begins at once to feed upon the good things provided for it by the instinctive labours of the mother Bee. Another photograph shows us a leaf-cell with part of its side removed, and the



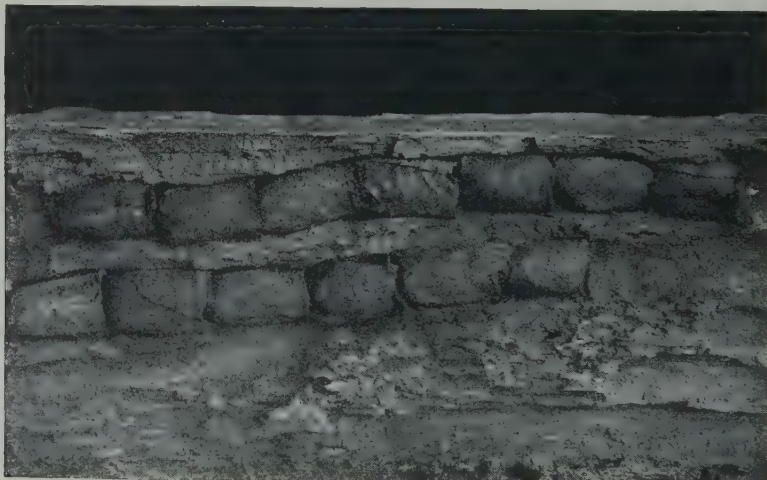
LEAF-CELL CUT OPEN TO SHOW HALF-GROWN BEE-GRUB FEEDING UPON HONEY WITHIN (MAGNIFIED).

half-grown grub within, literally wallowing in syrup. It is a remarkable fact that the Bee mother puts just enough food into each cell, and no more; so that when the grub has licked up the last drop of syrup its appetite is satisfied. Thereafter it

spins within its leaf-cell a cocoon of silk, coarse without but very fine within, and with a kind of cap at one end which—when the grub ultimately becomes a perfect Bee—is readily cut away.

A curious detail connected with the transformation of the Leaf-cutting Bee is that the grub, when it has finished its cocoon, does not at once become a pupa. In fact, it remains what it is throughout the whole winter, and only becomes a pupa in the springtime, a few weeks prior to its assumption of the imago condition.

Many solitary Bees pack their cells one after another into a tunnel bored in the ground or in rotten wood, and a moment's thought will show the reader that, should any of the insects at the end of this Indian file come to maturity before those which are nearer to the opening of the tunnel,



SECTION THROUGH ROTTEN BEAM, SHOWING TWO TUNNELS PACKED WITH LEAF-CELLS BY LEAF-CUTTING BEE.

they will be unable to effect their escape easily. The great French entomologist Fabre conducted experiments with certain of these Bees, in order to ascertain how they behaved in these circumstances. He found that if the imprisoned Bees could not cut or force their way between the cells in front of them and the side of the tunnel, they in no instance injured the cells themselves. Rather, they waited patiently until the way was cleared for them by the maturing and escape of their brothers and sisters in front. Whether the Leaf-cutting Bee is similarly patient, I am not yet able to state, though I know of no reason for suspecting it to be otherwise.

The Leaf-cutting Bee has several enemies, one of which is a near relative. It is known as a "Cuckoo" Bee because its habits remind one of those of the cuckoo among birds. The mother Leaf-cutting Bee forms her cell, provisions it, and lays her egg. While she is away cutting the leaf-fragments with which to cap the cell,



COCOON OF LEAF-CUTTING BEE, SHOWING
NUMEROUS PUPÆ OF THE CHRYSID
PARASITE WITHIN (MAGNIFIED).

the Cuckoo Bee steals into the tunnel and lays one of her eggs side by side with that of the rightful owner. The usual result is that the Cuckoo grub devours most of the food, while the grub of the Leaf-cutting Bee pines and dies. There are also certain minute Wasp-like insects, belonging

to the family *Chalcididæ*, which contrive to lay their eggs within the cocoon spun by the Leaf-cutting Bee grub. Exactly how they manage this I have not discovered, but they are very tiny, and so would be quite capable of forcing their way between the leaf-cells and the sides of the tunnel. Their egg-tubes, or ovipositors, would then enable them to pierce the wall of the cocoon. The tiny grubs of these Chalcid Wasps prey upon the big sleeping Bee grub, and ultimately devour it. Each is then transformed into a tiny pupa. I give a photograph of a Bee's cocoon with the side cut away. The whole interior is packed with Chalcid pupæ, while not a vestige of the rightful owner remains.



FEMALE LEAF-CUTTING BEE, WITH THE ELEVEN PIECES OF LEAF WHICH
USUALLY GO TO THE MAKING UP OF A SINGLE CELL.



LATHRÆA SQUAMARIA (THE TOOTHWORT).
A species which is parasitic on Hazel roots.

CHAPTERS IN PLANT LIFE

III—THE PLANT AS A HOST

By S. LEONARD BASTIN

With Photographs by the Author

APART from the food and shelter provided by vegetation to animal life, one is not perhaps accustomed to think of the plant in its character as a host. Yet the question of entertaining guests enters largely into the existence of many species, and is a much more important matter than might at first be supposed. In considering the relations of the flower and the living agents which carry the pollen, we shall see how well the plant is able to reward those willing to render the required aid, but on the present occasion it is proposed to consider

some far more intimate alliances. In some cases it is possible to show that the connections are of direct benefit to both the parties concerned—the plant providing housing, and even food, in return for services rendered. Other instances are more puzzling, in that although the plant does not appear to derive any advantages from its guests, yet it is willing to tolerate their presence, and even make some provision for their welfare. Finally, we find the plant as an unwilling host, with exacting visitors quartered upon it whose demands may be pushed to such an

extent that the very life of the host is at stake.

It has for long been realised that the relations between the plant and the ant present some remarkable points. The frequency with which these active insects are to be found in flowers cannot fail to have attracted the attention of observers. Now, in a certain way, the worker ants are not in the flower for any good purpose, having come to feast on the pollen and nectar. As these insects do not possess wings, they are not helpful in carrying the pollen from one plant to another, as bees and flies often do. Yet we cannot ignore the fact that in many cases the presence of ants in flowers is tolerated, if indeed it is not actually encouraged. As is well known, ants are peculiarly intolerant of the presence of other insects, and there seems no question that on occasion they will render ill-protected flowers a service in eating up other small marauders which come to plunder. It has been said, although the statement lacks confirmation, that ants will sometimes frighten bees away from flowers by the attacks which they make upon them. If this be so, the guests are certainly exceeding their duties in driving away the helpful bees.

Certain plants are seen to develop nectaries in other parts than the flowers. In the common Laurel these occur at the bases of the leaves on the under side. The Cherry, as well as other allied species, produces nectaries in the form of small glandular swellings on the leaf-stalks. In addition, it is found that the Broad Bean bears nectaries on its stipules. The actual purpose served by these processes has long been the subject of a great deal of speculation. Some have held that they must be regarded as curious protective

devices. It is argued that creeping insects bent on plundering the store of good things to be found in the flower are turned aside from their nefarious purpose when they discover the glands secreting nectar. Here is a supply of honey easily secured, so why should the little creatures trouble to go on to the blossom at all? In the case of the Scabrous Balsam, Kerner has observed that the drops of honey provided at the base of every leaf undoubtedly prevent a large number of wingless creatures from getting to the pollen. But it seems that the matter may be pushed to a still more interesting conclusion. These extra-floral nectaries will, of course, attract large numbers of ants, and the vigorous little creatures will certainly not allow any other visitors. Thus the numbers of small beetles and other insects which happen to be trespassing on the plant are dealt with very effectually.

The relations of plants and ants are known to be more definitely intimate than in any of the foregoing instances. As long ago as 1688 the old naturalist John Ray observed the frequent occurrence of ants in the hollow stems of *Cecropia palmata* and some other South American plants. It was not until the

latter part of last century that an understanding of the matter was in any way complete. The actual observations were made in the case of the Bull's Horn Acacia. In this tree it was found that the hollow thorns were inhabited by ants, the insects making a hole for their entrance and exit near one of the thorns. In these little homes they rear their young, and Belt (in Nicaragua) declared that in the wet season every one of the thorns in the trees he examined was inhabited. If any browsing animal should attack the tree, the ants resent the in-



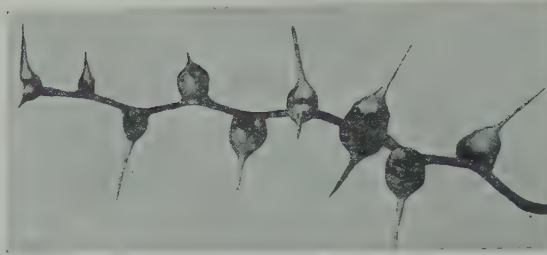
YELLOW RATTLE, A PLANT WHICH IS PARTLY PARASITIC ON GRASS ROOTS.

interference with great fury, rushing out to deal with the aggressor with jaws and stings. The services rendered to the Acacia go even beyond this.

The South American forest trees are much

subject to the onslaughts of leaf-cutting ants, whole armies of which will, at times, render a district almost denuded of foliage in a short while. The Acacias, which have enlisted the sympathies of the thorn-dwelling ants, are perfectly secure from attack. When the leaf-cutting species arrives on the scene it is to find the situation already occupied by hordes of ants fired by the enthusiasm which the defence of a home will always inspire. It is interesting to note the manner in which the ants are encouraged to take up their residence in the thorns. These when young are quite soft, and have their interiors filled with sweet edible pulp. As the insect eats away the contents of that which is to be its home, the thorn swells at the base and thus becomes more commodious. As well, at the bottom of each leaflet there is produced a small sweet gland, and in addition a tiny yellow food body at the end of each division of the leaf. So that it will be seen that the tree makes handsome provision for its army of defenders. It is only during the wet season that such liberal arrangements are made for the welfare of the ants. As soon as the time for the sending out of young shoots is past the honey glands dry up, and, left without their food supply, the majority of the ants perish. A sufficient number, however, survive to carry on the race during the time of scarceness.

Recent investigation has shown that the story of this strange compact between the ant and the Acacia trees is not at all exaggerated.



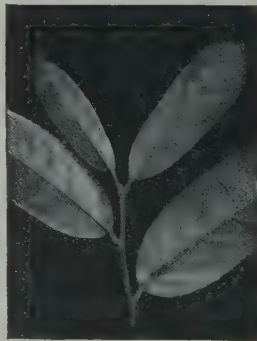
AN ACACIA WITH SWELLINGS AT THE BASE OF THE THORNS, WHICH ARE INHABITED BY ANTS.

The same state of affairs has been observed in quite a number of trees. In the case of the hollow-stemmed Cecropias, it has been found that the specimens which had suffered from

the attacks of leaf-cutting ants were for some reason or other without their body-guard. With the Cecropias the ants enter the stems by means of a little door which they always make at one spot on the stem where the tissue is very thin. Here also the plants are provided with a plenteous supply of food. Near the base of the leaf-stalks are to be found brown patches on which are a collection of oval bodies. These are highly nutritious, and are eaten greedily by the ants. It is certainly significant that, both in the case of the Cecropias and the Acacias, the food bodies are absent where the particular species is not inhabited by ants.

It must not be supposed that in all cases where ants and other small creatures are found to be associated with plants it is possible to make out a clear case of mutual help. The curious plant *Myrmecodia tuberosa*, from the Malay Archipelago, is a case in point. The species is altogether most singular in appearance, and consists of a tuberous growth spreading on the branches of old

trees, from the upper part of which spring the fleshy stems bearing the foliage. Every part of the tuber is tenanted by small red ants of a very fierce habit, which rush out and defend their homes when any attack is made. Some years ago, certain observers declared that it was through the agency of the ants that the tuberous growth was formed. The story was seriously placed on record that the bites of the ants caused the



LAUREL LEAVES SHOWING NECTARIES.

basal swelling, and also the formation of galleries in which the insects subsequently took up their abode; failing these attentions, it was declared that the vegetable invariably died. This has of recent years been entirely disproved, for it has been shown that specimens of *Myrmecodia* may be easily raised from seed and grown to a perfect development, even if ants are entirely excluded.

The *Yucca* plants are natives of America, and when the specimens are in flower a little moth, known as *Pronuba yuccasella*, may be seen flying round the blossoms. The females of this species spend most of their time in the blooms, where they make arrangements for a novel form of egg-laying. The moth starts with the rolling together of a ball of pollen. As soon as this is ready, it is carried off to another flower, where the insect lays an egg at the base of the pistil, by thrusting its ovipositor down through the soft tissue. This done, the moth mounts to the summit of the style and places the ball of pollen upon the stigmatic surface, thereby ensur-

ing the fertilisation of the ovules. When the caterpillar hatches, it finds itself supplied with food material in the surrounding tissues; there the larva will remain until the ripening of the seed, when it eats its way out, crawls to the ground, and then turns to a chrysalis under the surface.

As a general rule the numerous galls which are found so abundantly on the Oak, and also on certain other trees and plants, cannot be said to be harmful to the vegetable. Now and again, when the insects producing them become very abundant, growth may be stunted by the presence of the galls; or, as in the case of the dreaded Grape Louse of Southern Europe (*Phylloxera*), the plant perishes under the attacks which the minute creatures make upon it. Mostly, however, the plants seem to be neither better nor worse for having to develop the little houses in which the insects find a residence. Everyone must be familiar with the large round "gall nuts" which are found on the twigs of the Oak. Whilst



THE DODDER (*CUSCUTA EPITHYMUM*) ON HEATHER, A COMMON BRITISH PARASITE.

these are, of course, produced by the plant, the underlying cause of growth consists in the irritation set up by the minute gall wasps when the insects lay their eggs in the buds. These particular galls are but types of an immense number of examples exhibiting a wide range of form and size. Moreover, the life histories of the insects with which they are associated are in many cases imperfectly understood.

A very singular case of partnership between plants is that which is seen in the case of the Lichens. These used to be regarded as distinct individuals, capable of definite classification on the lines of other plants. It has been established that this is entirely a mistaken impression. Researches have shown that the Lichen is not a separate plant at all in the ordinary sense of the word. Rather must it be regarded as a case of that which has been called "symbiosis"—literally, the living together of two very distinct organisms. Every growth of Lichen must be thought of as a colony composed of thousands of individuals, in which, however, there is always one predominant. The chief partner of this strange alliance is a fungus, which encloses in its embrace a countless number of green Algæ.

In a certain sense it may be said that the fungus is parasitic upon these minute organisms, but only to the extent of stimulating the Algæ to great activity and vigorous increase. Both partners to the alliance appear to receive benefits from thus living together. Although at first this startling theory aroused an immense amount of opposition, there is no longer any doubt as to its correctness. The most convincing proof was that advanced by Stahl, who after some patient experiments at last succeeded in making Lichens by artificial methods. He took a well-known species of Algæ, and on this scattered the spores of a fungus. The result of this union was a Lichen in the form of a well-recognised growth. Again, it is possible to take any of the so-called species of Lichen, and start the constituents of the double organism on a separate existence. It is then seen that the little cells of the Algæ flourish and multiply, whilst the fungoid element of the union as surely starves.

Now and again it is found that a lichenous growth of one type may embrace several distinct species of Algæ—familiar examples which are well known apart from this strange alliance.

A little-understood union is that to be seen in the case of Beeches, Birches, and some other trees. Here it is seen that the root tips are infested with a network of fungus threads. It has been suggested, although not actually proved, that the threads act as a kind of sponge between the roots and the soil, possibly taking some part in the transmission of moisture. In some instances it is known that the fungus threads really penetrate the substance of the roots, but it does not appear that any harm results.

In the tropical forests the branches of the trees offer resting-places for a host of plants. These species are entirely isolated from the ground, and were at one time regarded as parasitic in habit, but such is not the case. They lead quite independent existences, carrying out the elaboration of their chlorophyll in the ordinary way. For their moisture and mineral matters these perched plants rely upon rain and the atmospheric dampness which is such a feature of the steamy jungles. It is interesting to note that the roots of most Epiphytes are specially adapted for absorbing moisture from the air, the skin being of a peculiarly spongy nature. There is little doubt that in many cases the débris composed of rotting leaves, which collects in the forks of the branches, forms a good rooting medium. A large group of plants in tropical America is formed by the many species of *Tillandsia*.

One of the most curious of these, known as "Spaniard's Beard" (*T. usneoides*), offers an example of a conspicuous and widely distributed Epiphyte. This species has no real roots, but drapes itself round the branches of its host by means of its long thread-like stems of a silver-grey colour. A good proof that the *Tillandsias* are not in the least dependent upon soil is to be seen in the case of another species of *Tillandsia* at Kew. This example, which comes from Trinidad, has been suspended from the roof of a greenhouse for a long time. The roots of the specimen are simply in the warm, damp atmosphere of



THE STORY OF THE YUCCA.

the hot-house, yet the plant thrives perfectly well. The great Aroids of the genus *Philodendron*, and the strange *Monstera*s, perch high in the branches of trees, whence they send down long aerial roots. Although a great deal of moisture is absorbed from the air by these processes, they not infrequently find a final resting place in the damp soil beneath. As is well known, a large number of tropical Orchids are epiphytical in habit, and by their gay flowers adorn the branches of the forest trees with loveliness.

The plant is called upon to provide accommodation for many of its own kind, but it is to be feared that in a large number of cases the guest is not a welcome visitor. Quite often the host does not suffer greatly from the attentions which are pressed upon it. The mildly parasitic Mistletoe does not appear to be a great drain on the resources of the trees upon which it grows. The plant selects a wide range of hosts, embracing nearly all kinds of the common deciduous trees. In Britain, at any rate, the Mistletoe is chiefly found on the Black Poplar. The manner in which the parasite is distributed is very interesting. In winter the white berries are largely eaten by birds, and a certain number of the seeds will be likely to adhere to their beaks. To get rid of the encumbrance, the bird cleans his bill by rubbing it backwards and forwards on the bark of a branch. In this way the seed is placed in the best possible position for its purpose. As the seed germinates, roots are sent down into the tissue of the branch on which it rests, and the Mistletoe becomes quickly established. We may see from the leaves of the plant that it is not a very depraved parasite, the pale green foliage indicating that the elaboration of chlorophyll is carried on to a certain extent.

The story of the Dodder, a parasite of the most abandoned description, is a very different one from that of the Mistletoe. These remarkable plants, of which there are several species found in Great Britain, have given up all attempts to make a living for themselves in the proper manner, and have appeared on the scene as undisguised robbers. The life history of a typical species (*Cuscuta epithymum*) is most curious. The seed

of the plant germinates in the soil in the usual manner of most plants. One fact which is significant is that, unlike most other flowering plants, the embryo of the Dodder is not provided with any reserve of food material. What little nourishment the developing plant requires, until it can enter upon its parasitical career, is drawn from the albuminous matter within itself. Soon after germination the thin radicle pushes its way down into the soil; meanwhile a red filament spreads upwards. It is a matter of urgency that the young Dodder should at the earliest possible moment be able to find a host, unless it is to perish miserably. The red shoot elongates at a considerable rate, and finally comes into contact with a suitable plant.

The particular species under consideration is very partial to furze and heather. At once the character of the plant is revealed; the root dries up, the harmless-looking threads produce suckers at the points of contact, and entwine themselves round the stems of the unfortunate plant selected as a victim. From thenceforward the red shoots of the Dodder increase at an incredible rate, thrusting out in all directions, and, wherever possible, affixing the suckers which drain away the life from the miserable host. About July, the Dodder develops its clusters of small white flowers, and soon afterwards the red filaments decrease in the vigour of their growth, and the parasite finally disappears. Quite often the plant which has been attacked is so miserably weakened that it perishes before the Dodder; but the activities of the parasite are such that it quickly transfers its operations to any adjoining specimen which may be suitable for its purpose. As showing what a formidable enemy the Dodder may be to the plant, even the hardy furze bushes not infrequently fall victims to the onslaughts of the parasite.

Of root parasites there are two very distinct groups—those which are only partially dependent upon their hosts, and those which can in no way support a separate existence. The common woodland plant, the Cow Wheat (*Melampyrum*), attaches itself by discs to the surrounding roots of its neighbours, yet this union

PLANT LIFE

DESCRIPTION OF PLANT—Wild Arum (“Lords and Ladies”)

(*Arum maculatum*)

Specimens required :—PLANTS OF WILD ARUM

Examine plant as follows :—

1. *Root system*.—A ring of fibrous roots growing from the corm.
2. *Stem*.—Note the corm forming on growth of previous year. Cut through and note wasting of the old corm. Test with iodine for starch. Observe the white fleshy stems and sheathing process of leaves.
3. *Leaves*.—Hastate, dark green, spotted with purplish brown.
4. *Flower*.—The spadix is enveloped in a spathe. Also the spadix is coloured, and incomplete flowers appear at its base. Note fertilisation by insects.
5. *Fruit*.—This is composed of bright scarlet berries which are extremely poisonous. These are conspicuous in autumn.
6. *Habitat*.—Hedges and woods.

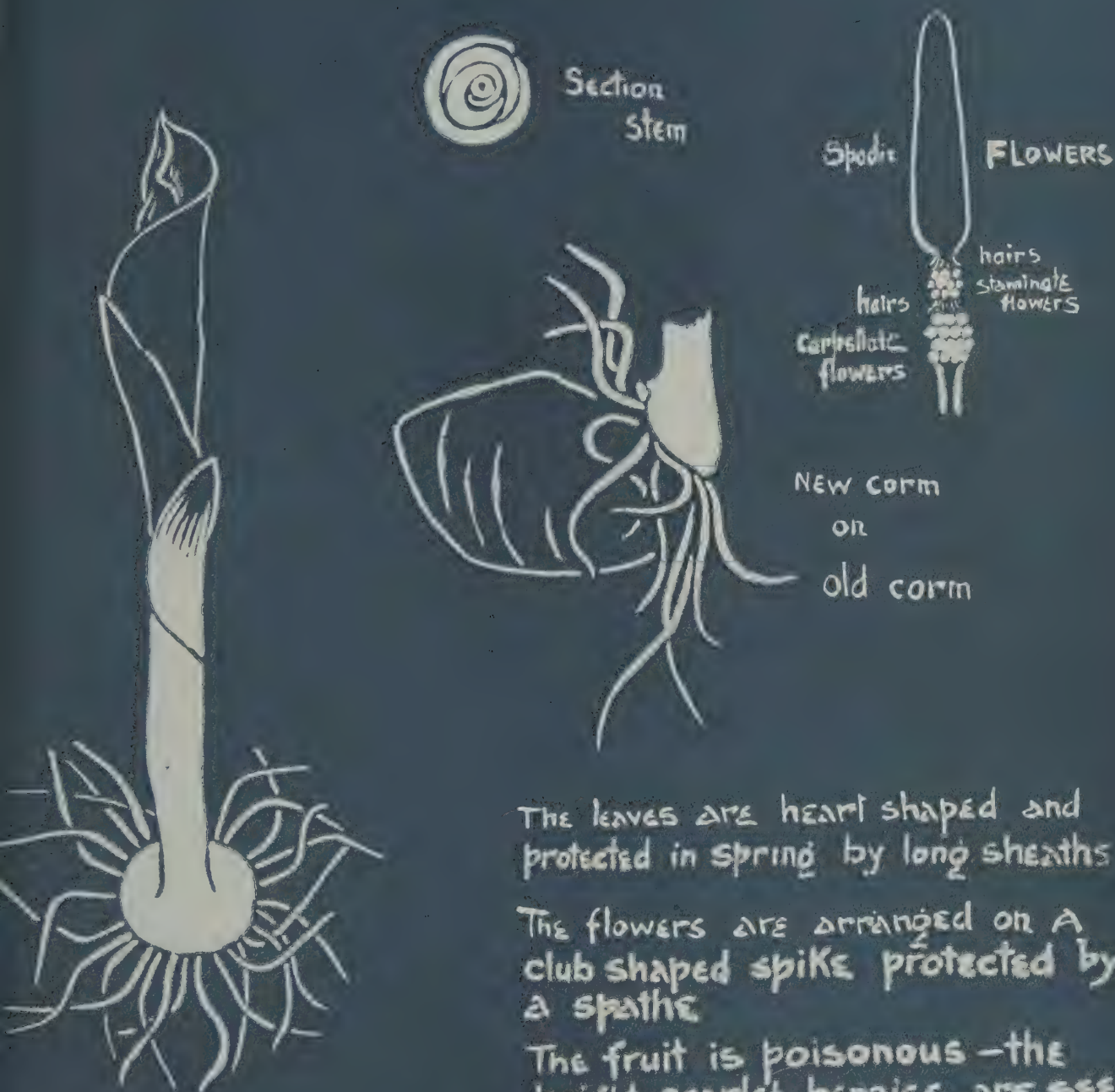
Make cross sections of stem. Draw diagrams of parts examined.

Examine in similar way the following :—

Wild Hyacinth, Daffodil, Iris, Orchid, Buttercup.
Poppy, Wallflower, Campion, Herb Robert.

THE PLANT

LORDS & LADIES (*Arum maculatum*)



The leaves are heart shaped and protected in spring by long sheaths

The flowers are arranged on a club shaped spike protected by a spathe

The fruit is poisonous - the bright scarlet berries are seen in autumn.

The roots grow out from a corm
A new corm forms each year

only occurs in the case of a proportion of the roots. The plant has, too, independent soil roots, and at the same time develops perfectly green leaves. In much the same way the Yellow Rattle (*Rhinanthus*) of our pastures attaches some of its roots to the underground runners of grass. Yet so green is the foliage, and so abundant the independent roots, that the plant can only draw to a small extent upon the resources of its host. These two species are only types of several hundred plants, existing in various parts of the world, which live partly at the expense of their hosts by means of root attachment.

There are few more curious plants than the Toothwort (*Lathraea*), a species which is wholly given over to parasitism. Owing to the courtesy of Mr. E. J. Allard, of Cambridge, the writer is able to give an illustration of the Toothwort. Though not common the plant has a wide distribution, being found on the roots of Poplar, Hazel, and other trees. The Toothwort is very easy to establish, and it may be seen growing in great abundance in several botanic gardens. The appearance of the plant is very singular, with its thick spikes of pale lilac-tinted flowers. Below the surface of the soil it is possible to see the manner in which the Toothwort gets a living. From the roots of the plant arise suckers—in one species (*L. clandestina*) as large as split peas—by means of which the roots of trees are penetrated. Another plant of similar habit to the Toothwort is the Broomrape (*Orobanche*), which grows as a parasite on the roots of many common plants, notably Broom and other leguminous species. The Broomrape has, of course, no true leaves, and looks more like a withered flower-spike, so dingy is the colouring of its inflorescence. There are several species of *Orobanche* to be found in

Britain, one of which (*O. major*) is quite frequently to be met with. It does not seem that these root parasites are actually very harmful to the plants upon which they force their attentions.

One could not very well leave the subject of plant parasites without a reference to that wonder of the world, the *Rafflesia Arnoldi*. This species, which was discovered in Sumatra in 1818 by Dr. Arnold, is so curiously modified that it is almost reduced to one giant flower. The blossoms are of colossal proportions, measuring as much as three or four feet in diameter. The *Rafflesia* usually attaches itself to the roots of the trees which are close to the trunk, and presents a most striking appearance. The colouring of the enormous petals is of a lurid reddish brown shade, and the flower is said to attract large numbers of winged insects.



TILLANDSIA, OR "OLD MAN'S BEARD."



NEST OF WHITETHROAT.

SOME TYPES OF BIRDS' NESTS

By BENJAMIN HANLEY

Illustrated with Photographs by the Author

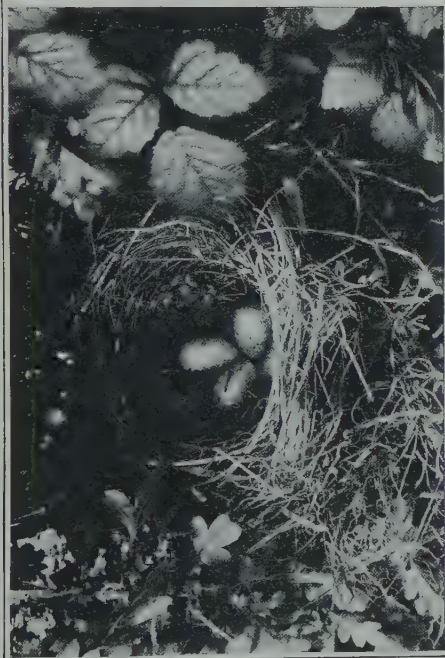
ON viewing a Chaffinch's neat, lichen-covered, cup-shaped nest, one is struck with its symmetrical outline and general beauty and possibly wonders why it is that all birds do not make their homesteads equally beautiful. Whilst some nests appear trim and neat, others seem to be the very essence of untidiness; but if one pauses to think, it will be seen that the fact of their being tidy or otherwise does not enter into the plan of the builders. Each is adapted for its owner's needs, and one and all are built for utility. Viewed in this natural light, all nests have equal beauty, and those special degrees of elegance which one at first admires are merely points of adaptation to its surroundings.

Take, for instance, the Chaffinch's nest. Why should the exterior be decorated with cobwebs and grey lichens? Simply

to minimise the risk of detection. As often as not it is placed in the fork of a small tree either in gardens or woods, and the outside of the nest harmonising with its surroundings—*viz.* grey bark—it is easily overlooked.

The Lapwing, or Green Plover, merely collects a few straws and grasses; often even these are omitted, and the eggs laid on the bare ground. What use would an elaborate nest be to this bird? None whatever. It would simply lead to the discovery of its eggs, whereas the few grasses which it collects appear as but a handful of rubbish such as might easily be blown together by the wind; and where no materials are used there is even less danger, for the eggs agree so well with the bare soil.

The Kentish Plover, which lays its eggs amongst stones by the seashore, makes



1



2



3



4

1. NEST OF BLACKBIRD.
3. NEST OF BLACKCAP WARBLER.

2. NEST OF WILLOW WREN.
4. NEST OF MOORHEN.

absolutely no nest, and yet its eggs are possibly more difficult to discover than those of any other bird. Imagine a stretch of beach several miles in length and of considerable width, covered with smooth pebbles, and one will readily understand that it is only by watching the birds one is able to find their eggs, otherwise the beach might be searched for weeks without result, the fact being that there is no nest to search for after all.

Gulls which nest on ledges of the cliffs make very little nest, only a kind of ring sufficient to prevent the eggs rolling off the ledge; but those which have forsaken the cliffs, and nest in inland marshes and tarns, build a more bulky nest of grasses and reeds, simply because it is essential that the eggs be kept clear of the water.

On the other hand, that of the Little Grebe, or Dabchick, which floats on the water, is a low pad of decayed vegetation, soaked with water, and the eggs, to all intents and purposes, one might say, are in the water also.

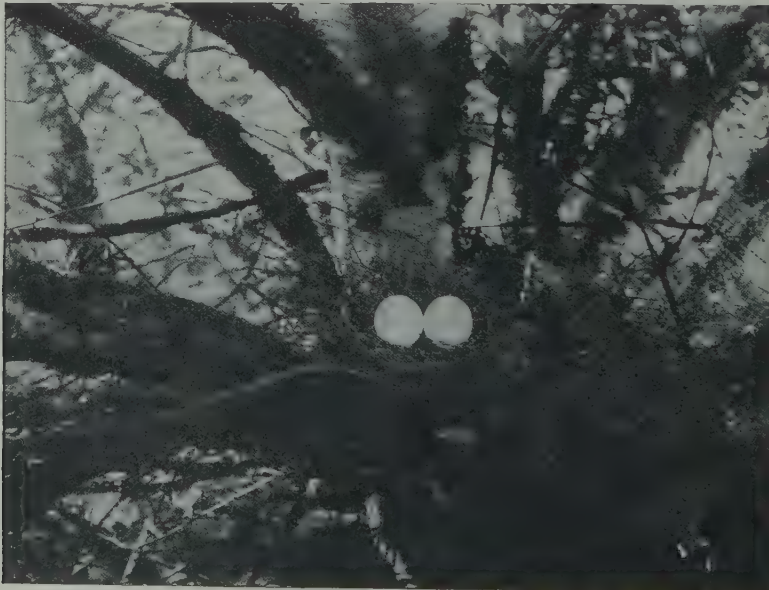
The Coot's homestead is usually a large, bulky structure; but even then until near at hand it looks more like a collection of reeds and rushes accidentally formed than a nest. This also applies in

some cases to the lesser nest of the Moorhen.

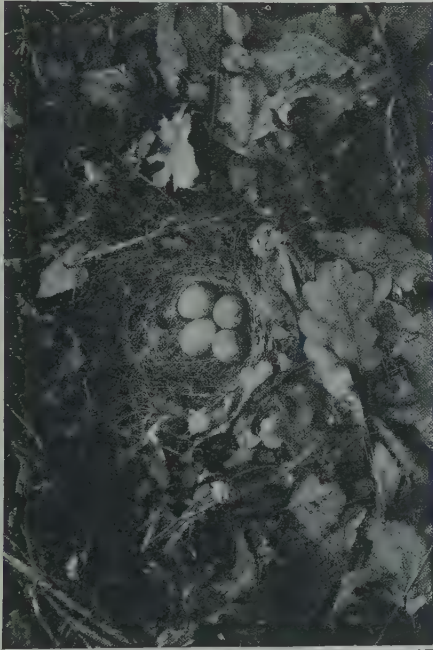
Some nests are partially domed, like those of the Chiffchaff and Willow Wren, and as these are placed on the ground amongst vegetation they well answer their purpose. From above, if at all visible, the nest appears to be a lump of dried grass or hay, whereas were they simply open nests the risk of the light-coloured eggs being noticed would be all the greater. Again, the dome serves the additional purpose of shielding the eggs or young from moisture. After a shower, for instance, the vegetation around such nests is simply saturated with water, and but for the dome this would drip on to the contents of the nest.

Of course, birds have no reasoning powers; they simply build by instinct, and this sometimes plays them pranks.

The Common Wren's nest is usually well concealed, but recently I heard of one of these birds using a crevice in a brick wall and leaving long straws hanging from the nest, which could be seen from a great distance, and rendered it conspicuous. Why did the Wren make such a mistake? It was simply obeying instinct without reasoning. It was one of a brood reared from a nest built of straw in a hedge



NEST OF TURTLE DOVE



1



2



3



4

1. NEST OF ROBIN.
3. NEST OF BLACK-HEADED GULL

2. NEST OF HEDGE SPARROW.
4. NEST OF LAPWING.



NEST OF PARTRIDGE—A FULL CLUTCH.

tangled with straw blown by the wind from a neighbouring stack. In that case the nest harmonised with its surroundings, but the following season the bird, using the handiest materials, secured a result calculated to lead to discovery rather than concealment.

The birds invariably use the handiest materials, and these usually conceal the nest; but, as I have shown, some odd times the very opposite occurs. I have found nests of the Wren built of hay pulled from the stack in the side of which it was built, and another in the side of an old willow tree formed of dead leaves picked up near by. This latter looked exactly as a collection of leaves blown together would do—and so both served their purpose.

Why should the nest of the Missel Thrush, in addition to being lined with mud, have a lining of fine hay or grasses, whilst that of the Song Thrush has only the first lining of mud and bits of rotten wood? Both need stiff mud sides to hold the heavy youngsters, but whilst the Missel Thrush builds in exposed situations, the Song Thrush usually places its nest behind a stump or other sheltered spot. With rain a simple mud lining would soon become soft, and without the inner lining of grass would bedaub the eggs or

young. Thus we see the more exposed nest provides for this contingency.

For nesting in remarkable situations the Robin, without doubt, takes first place, building anywhere from an ivy-clad bank to the interior of an old kettle or tin. In our illustration the nest is amongst oak leaves in a wood, and when the bird was covering her treasures there was no perceptible difference between the colouring of the bird and the surrounding leaves—a case of protective resemblance.

Birds nesting in holes build a very loose nest, simply because the sides of the cavity prevent its falling apart, and it has to undergo no rough usage by the wind.

The majority of Warblers build a kind of swinging nest, a very slight structure indeed, slung between the stems of herbage or briar out of sight. Slight as these nests are, they are not damaged by the swaying of their supports; indeed, their very lightness proves their utility, for it gives elasticity, and these frail nests are the best that could be made for their surroundings.

Many more examples could be mentioned, but sufficient has been said to show that birds have probably no eye for beauty and no reasoning power, but simply build by instinct, from the handiest materials, a nest best suited to their purpose.



HAYMAKING.
From the Oil Painting by A. E. Bottomley.

THE BUTTERFLY OF THE OAK

By HAROLD BASTIN

With Photographs by the Author

THE *Lycænidæ* are a large family of small or moderate-sized butterflies which are distributed in all parts of the world. They may be roughly classified into three groups, which we may here designate by

their popular names, to wit, the "Blues," the "Coppers" and the "Hairstreaks."

Of these latter we have in Britain five species, two of which are rare. Superficially, all the species bear a considerable resemblance one to another, a characteristic feature being a more or less developed "tail" near the anal angle of the hind-wing, although this is not pronounced in the Green Hairstreak, which also differs from the other species in not possessing distinct whitish streaks on the underside of the wings. These butterflies agree with other members of their family in the possession of six perfect legs—a point, by the way, of considerable importance, seeing that in certain families of butterflies only four legs are sufficiently developed for walking.

The particular Hairstreak which is to

form the subject of this article is, as my title indicates, especially associated with the oak. Indeed, of all the British butterflies it is the only one whose caterpillars feed exclusively upon the leaves of this



THECLA QUERCUS, NEWLY EMERGED (GREATLY MAGNIFIED).

Showing beautiful underside coloration.



THECLA QUERCUS CATERPILLAR.
(Magnified.)

tree. Its scientific name is *Thecla quercus*, while it is known popularly as the Purple Hairstreak or the Oak Thecla. There is scarcely an oak wood in England, at least in the south, which is not graced in summer-time by the presence of this butterfly; while it is well known in Ireland and in many parts of Scotland.

Beside being the commonest member of its genus, it is indisputably the most lovely. Let me briefly describe its charms. The outline of the wings is somewhat angular, owing to the costal and hind margins being nearly straight, while the tip, or apex, is only very slightly rounded. The outer margin of the hind-wing is slightly scalloped, and bears the little "tail" already referred to. The ground colour of the wings, on their upper surface, is brownish black, in the males overlaid, so to speak, with a rich purple gloss, save for a narrow area at the margins. In the female, this purple gloss is confined to a patch which occupies a portion only of each fore-wing; but while abbreviated in its extent, the colour is more rich and deep, and reflects the light in a manner reminiscent of the Purple Emperor's glorious sheen.

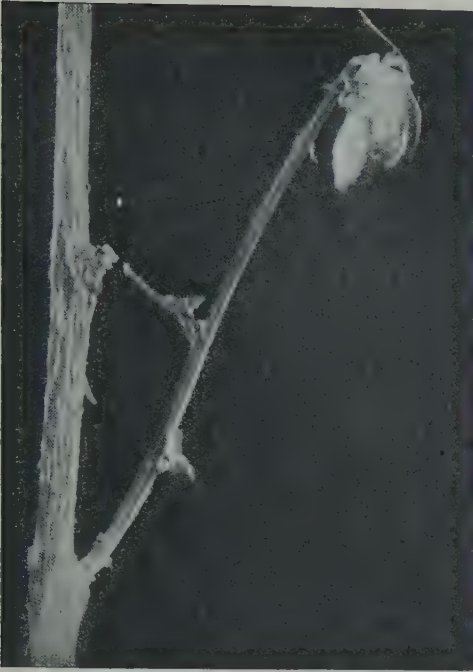
In both sexes, the under surface of the

wings is a delicate ashen grey, inclining to pale brown in the males. Stretching across the wing-area is a white line, edged with brown, which, in the hind-wing, makes a kind of double twist, so that it assumes somewhat the form of the letter W. In the case of a rarer Hairstreak butterfly, this curious mark is so characteristic as to have suggested both the popular and the scientific names, to wit, the White Letter Hairstreak (*Thecla W-album*). The magnified photograph of the Purple Hairstreak Butterfly, newly emerged from the pupa, and hanging from a twig, gives some idea of the beautiful under surface of the wings and of their delicate marginal fringing. But a photograph fails altogether to suggest the exquisite softness of the colour scheme, or the two orange spots, one being black centred, which adorn the anal area of the hind-wing.

The Purple Hairstreak Butterfly is on the wing in July and August. In the former month the eggs are laid by the female on the twigs of the oak (*Quercus robur*). Here they remain throughout the winter, exposed to the inclemencies of



THECLA QUERCUS CATERPILLAR.
(Natural size.)



THE BUTTERFLY FRESH FROM THE PUPA.



THE WINGS HAVE DROPPED DOWN

the weather ; but, as is the case with many other insects' eggs, they seem to be quite unharmed by cold or damp. In the spring-time, as the oak begins to put forth its leaves, the eggs hatch and the tiny caterpillars commence to feed. They are full grown in June—earlier or later in the month according to the state of the temperature in the spring, which may have hastened or retarded somewhat their hatching.

The full-grown Purple Hairstreak caterpillar is a quaint little object, and will repay

FEMALE *THECLA QUERCUS* READY TO FLY AWAY.

examination by means of a magnifying lens. In common with the larvæ of *Lycenidæ* in general, it is short and hairy, somewhat like a woodlouse in shape, or perhaps even more like the familiar shell known as the Chiton. Its head is small and retractile, being drawn back into the first body segment when the creature is at rest. A caterpillar is shown, considerably magnified, in the photograph on page 914; and its resemblance to the Chiton shell upon a rock will be at



THECLA QUERCUS, MALE AND FEMALE FROM ABOVE AND BELOW.

once apparent to those who have experienced the delights of a collecting ramble on the seashore.

The colour of the caterpillar is brown, sometimes tinged slightly with green or pink. Its back is very convex, and down the middle there is a kind of groove, darker in colour. Down the back runs a chain of markings, somewhat arrow-shaped, and pale brownish or pinkish in colour. It is not always an easy matter to describe in words the appearance of an insect in such a way that the reader will be able to recognise it at sight. In this instance, however, I feel justified in comparing the caterpillar, and its colouring, with the crumpled bud-scales of the oak which, in June, still remain at the bases of the petioles of the leaves. I have been so much impressed by this resemblance on many occasions that I cannot help thinking it must be another instance of "protective colouring."

It is easy to imagine that a hungry bird, peering among the oak foliage, might mistake this caterpillar for a little bundle of dry and worthless bud-scales.

When it has finished its feeding, the Purple Hairstreak caterpillar assumes its pupal form. As the time for the change approaches, the insect loses most of its colour and becomes bloated and sluggish. After lying in this state for some hours, practically without stirring, it commences a series of rhythmic movements—the muscles of its body seeming to rise in

waves from its head to its tail. By this means its skin is gradually worked backwards, in much the same way as one works a glove on to the fingers of one's hand. Eventually, the skin immediately behind the head splits, and the pupa begins to emerge. The rhythmic movements continue, and in a few seconds more the whole larval skin is completely worked off. At first the pupa is white, slightly tinged with pink, while it is about the same length as was the caterpillar. But it rapidly contracts, becoming ultimately stout and rounded. Its colour, too, soon darkens to deep reddish brown.

The foregoing remarks apply to the change from caterpillar to chrysalis as it takes place when the insect is in captivity, either upon the floor of the breeding cage or just beneath the surface of earth should this have been provided. For when in captivity this caterpillar does not spin any silk pad for its anal hooks, or fasten itself by means of a silk belt, after the common custom of its kind. Moreover, there is no doubt that the Purple Hairstreak caterpillar, even in its wild state, often pupates in the mould or moss at the foot of its tree trunk. But several authorities agree in stating that the pupa is normally suspended from an oak-leaf by the anal extremity and girded in the orthodox manner. The writer, however, has never yet been able to discover it in this position.

I have already said that the perfect

butterfly makes its appearance in July. The pupal skin breaks open at the destined moment, the captive creeps forth, and immediately ascends a neighbouring twig or grass blade—it matters not so long as the insect can secure a firm hold for its feet and a clear drop for its rapidly developing wings.

It is a fact that when the butterfly emerges from the chrysalis skin its every part is perfect, with the form and size of maturity, except the pad-like wings and the swollen and elongated abdomen wherein is contained the fluid which will ultimately flow into the wings. As soon as the butterfly has found a suitable spot, the afflux of this fluid causes the wings to grow very rapidly—so rapidly that in from five to ten minutes they attain their full size, although they are still wet, soft, and quite unfit for flight. An hour or more must elapse ere they become dry and firm.

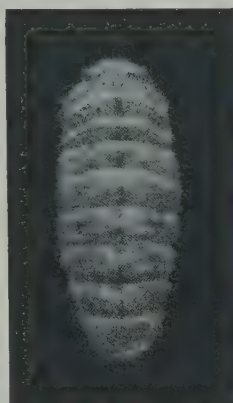
The rapid development of the newly emerged butterfly's wings is a marvellous spectacle, and calls for a word of explanation. It is brought about, as we have seen, by an afflux of fluid which is driven, chiefly by contraction of the abdominal muscles, from the body into the wings. The reader must know that the butterfly's wing is composed of two skins, or membranes, lying close together and supported by the veins. In the newly emerged insect the two membranes of the wing are corrugated—that is, each membrane is, so to speak, folded upon itself like a closed concertina. Thus, each wing is literally a bag which, as the fluid is forced into it from the body, would tend to expand like a balloon were it not that the membranes are held closely together by minute fibres or ligaments. As soon as the wings have dropped and expanded to their full size, the overplus

of fluid is discharged from the butterfly's body, and the insect then remains hanging, quite motionless, until the wings attain their normal consistency and firmness. The Purple Hairstreak Butterfly is then complete. It usually climbs to a point of vantage, opens and closes its wings once or twice as if to test them, and then soars away into the sunshine. It delights to frolic with its companions in woodland

glades and around the oak trees, often ascending to the topmost branches. It has a habit of selecting a special leaf as a point of vantage, to which, if disturbed, it will return time after time. In this respect it resembles the famous Purple Emperor (*Apatura iris*), which also selects a throne among the oak leaves. But although this regal butterfly in its perfect state is associated with the oak, its caterpillar must be looked for upon goat-willow or sallow bushes.

The Purple Hairstreak Butterfly has a wide range. It is common throughout Europe, except in the extreme

north and south, while it is also found in Asia Minor. But in Europe *Thecla quercus* shares its distinction as the Butterfly of the Oak with another species, viz. *Thecla ilicis*. As its name implies, the latter insect is especially associated with the evergreen oak (*Quercus ilex*); but the larva—which is pale green marked with yellow spots and lines—feeds also upon the leaves of *Quercus robur*. This butterfly is dark brown. The anal angle of the hind-wings is marked with a small orange spot in both sexes; while the female has a large, dull orange blotch on each fore-wing. *Thecla ilicis* is found throughout Central and Southern Europe, North Africa and Western Asia. It abounds in every oak wood in Germany from May to July. That it does not range into England is a fact difficult to explain.



THECLA QUERCUS
CATERPILLAR ABOUT
TO CHANGE TO PUPA
(MAGNIFIED).





THE GIANT'S CAUSEWAY—ONE OF THE MOST WONDERFUL EXAMPLES OF NATURE'S MASONRY.

NATURE'S MASONRY

By F. MARTIN DUNCAN, F.R.P.S.

With Photographs by the Author

IN all the seasons and throughout all ages Nature is for ever at work hewing and carving the face of the hills. She is indeed a mighty mason, and her tools are the rain and snow, the ice and frost, flowing stream, and beating waves. Nothing can be more delightful during our holiday rambles and country walks than to try and learn something about the ways in which Nature uses these tools.

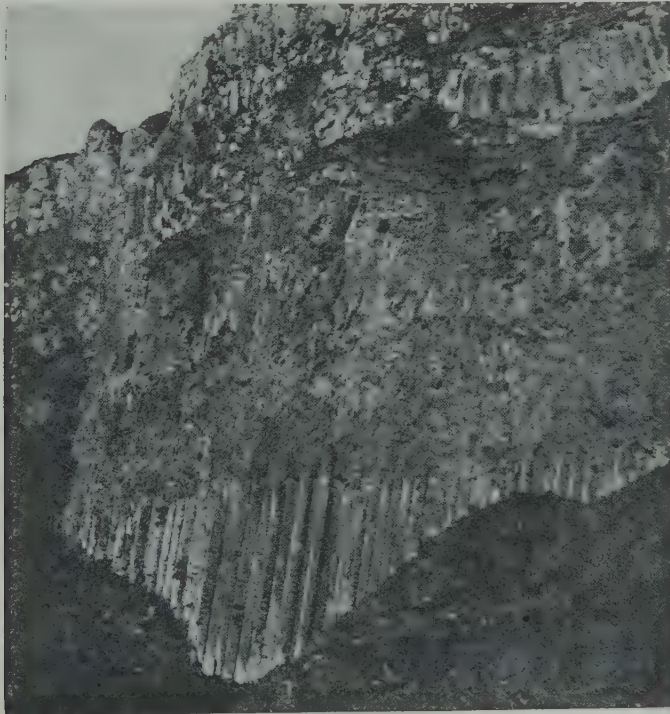
During our annual visit to the sea we have an opportunity of observing how she utilises rain and frost and the storm-

tossed waves in her masonry of the shore. A morning ramble along the shore from Bournemouth towards Poole will give us some insight into the way she carves the sand cliffs, using here for her principal tools rain and the inland springs. The sandy shore gently slopes upward from the laughing waters of a summer sea to the base of the brown cliffs, and as we look at them we see the rocks chiselled into buttresses and terraces, while here and there the face of the cliff is deeply scored. At the base of the cliff is a loose accumulation of fragments that have

slipped down its face during the progress of Nature sculpturing; this is carried away by the highest tides, but is constantly being replenished from above by the action of the springs, the wind and rain.

Ice is one of Nature's most powerful chisels wherewith she splits the hardest rocks. To see how this work is accomplished we must visit some high, exposed cliff on the mountain side after a night of frost. Perhaps the previous afternoon the clouds hung low upon the mountain, swathing it in a rolling mantle of grey mist, until every crack and cranny of the rocks was filled with water. As the night drew on, the temperature gradually fell lower and lower, until the moisture-laden rocks became coated with frost, and the rain that had accumulated in the crannies was converted into solid ice. Now these cold, dark hours have passed and the sun is shining gloriously, and as the frost and ice rapidly thaw, we begin to hear the tinkle of water, and ever and anon the sharp sound of falling stones, the chips falling from the work of Nature's chisel.

To understand clearly how this ice chisel works we must comprehend what happened to the water as it slowly froze and thawed again. Water as it grows colder contracts in bulk until it falls to a temperature of about $4^{\circ}\text{C}.$; on reaching $0^{\circ}\text{C}.$, the freezing point, it passes into the solid state, and at the moment of solidification suddenly expands; thus 91.75 cubic inches of water at $0^{\circ}\text{C}.$ will pass suddenly into 100 cubic inches of solid ice. We can now better realise the tremendous splitting power of Nature's ice chisel upon the rock. During the night, the water imprisoned in the clefts of the rock, as it froze, suddenly expanded, and by the force of its expansion split out large and small fragments of rock, which, however, did not fall at once, but were held in position by the grip of the ice. Now the sun beats upon the exposed surface of the rocks, causing the ice to melt, and releasing the split masses of rock, which fall down to the base of the cliffs. In their descent these newly detached masses strike against the face



THE LAYER ABOVE EACH ZONE OF THESE COLUMNS REPRESENTS
THE UPPER PORTION OF AN ANCIENT LAVA STREAM.



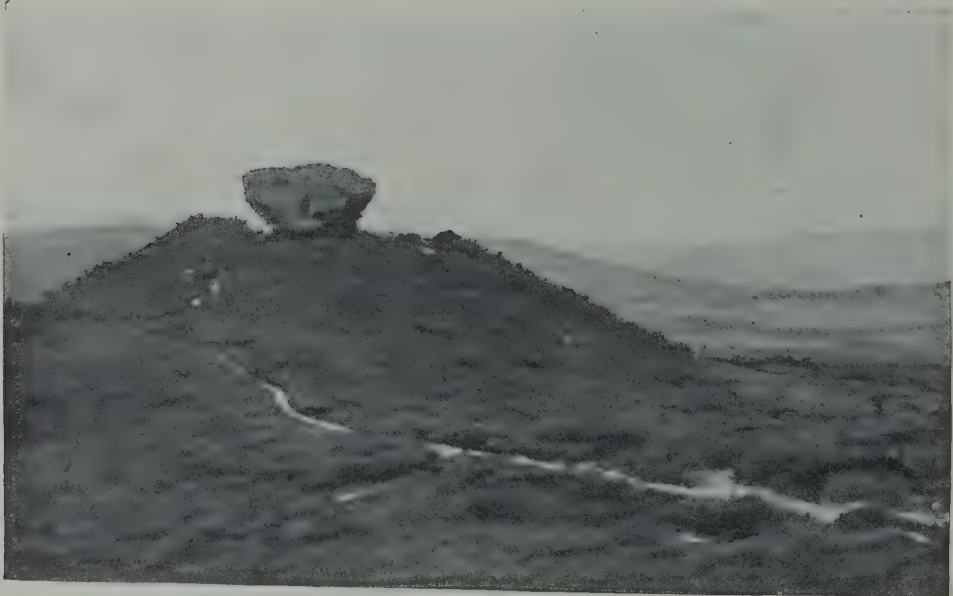
ONE OF NATURE'S TOWERS.

of the cliff, and dislodging other rocks that have been loosened by the action of

the rain and ice, sweep them downwards. In this way immense blocks of stone are split and wedged outwards down the cliff.

Rain is one of the most useful tools that Nature employs in her masonry, for in falling it dissolves and absorbs the gases of the air, and carrying these downwards exerts a powerful chemical action on the surface of the rocks. Those red-brown stains, so familiar in sandstone districts where the face of the cliff is exposed, tell of chemical decay, caused by the oxygen carried down by heavy rain making hydrated iron oxides as it percolates through the cracks and crannies. In the same way rain, taking up carbon dioxide from the atmosphere, attracts the limestone and forms pits and grooves in the surface of the cliffs.

A very remarkable example of Nature's masonry, chiefly formed by the action of rain and frost, is the Agglestone, or Haggerstone, which stands about 18 feet high upon a sandhill near Studland. It is an irregular weathered remnant of the Bagshot Sands, that owes its preservation to the induration of the sands, and forms a most striking feature of the landscape. It is only natural that this strangely shaped mass, standing out weird and isolated on the heather-clad plains, should



THE AGGLESTONE IS A GIGANTIC WEATHERED REMNANT OF THE BAGSHOT SANDS.

have stimulated the imaginations of our forefathers, and as a result the following quaint legend relating to the origin of the Agglestone has been handed down from monastic times. Tradition has it that when Salisbury Cathedral was in process of building, his Satanic Majesty was so enraged as he gazed upon it from the Isle of Wight, that he seized the Agglestone, and hurled it with all his force at the cathedral, hoping to obliterate it. But the Agglestone was miraculously arrested in its flight, and fell harmlessly upon the sandy hilltop at Studland.

The coast of the Isle of Purbeck affords

many interesting examples of Nature's masonry. Passing down to the coast again, after our examination of the Agglestone, let us in imagination set sail towards Swanage. As we pass out of Studland Bay, the great chalk cliffs of Ballard Down tower above us, and just before coming to the famous geological Fault, where the strata are seen to have been thrust upwards, we pass one of Nature's towers that she has chiselled out of the cliff with her tools, the waves, and the wind and rain. In the afternoon, when the cliffs are partly in shadow, this tall, white, conical tower stands out from



IMMENSE BLOCKS OF STONE ARE SPLIT AND WEDGED OUTWARDS.



"THE CLIFFS ARE BENT AND FOLDED INTO GREAT SWEEPING CURVES."



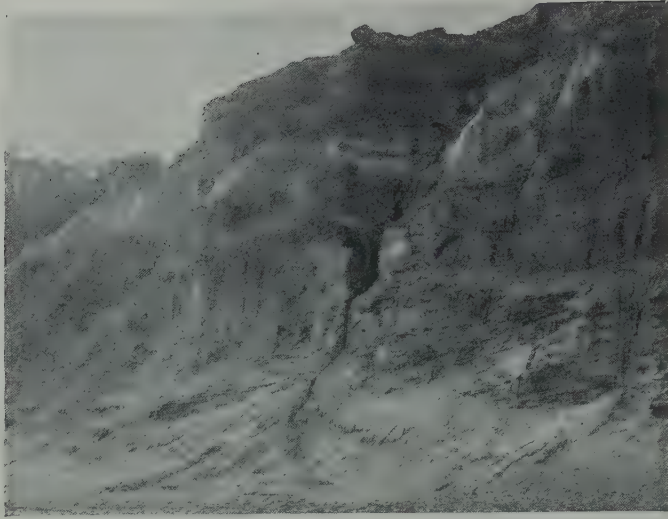
DURDLE DOOR IS ONE OF THE MOST BEAUTIFUL NATURAL ARCHES.

the coast, a most striking and beautiful example of Nature's masonry. Sailing onward we arrive at Lulworth Cove, and here the scene is wonderfully impressive, for the strata of the cliffs are bent and folded into great sweeping curves. At first one would be inclined to imagine that this great contortion of the surface of the earth must have been produced before the rocks had solidified, or that it is the outcome of some violent volcanic upheaval, but really Nature has slowly produced these wonderful sweeping curves by immense pressure brought to bear upon the rocks when they were at a great depth.

Not far from Lulworth is Durdle Door, one of the most beautiful natural arches to be seen in the west of England.

Amongst the most wonderful and, when we come to consider the forces used in their moulding, most awe-inspiring examples of Nature's masonry, are the beautiful basaltic columns which have made Staffa and the Giant's Causeway famous. The north of Ireland offers unique opportunities not only for the

observation of these basaltic columns, but also for gaining a clear insight into the history of our volcanoes which, in past geological ages, must have sent forth enormous lava streams over the country. As we pass in the train from Coleraine to Londonderry, the scenery is singularly grand and impressive. On our left tower the dark gloomy cliffs of basalt, telling of mighty volcanic energy in the past ages; while on our right are the recent sandbanks, and lovely blue, sun-kissed waters of Lough Foyle. If we tramp inland from the east coast right into the heart of County Londonderry, we shall find the surface of the country formed of gently swelling basaltic plateaux. There is an indescribable charm about the wild and almost desolate landscape, with its purple, heather-clad uplands and broad, nearly treeless levels of bog land. As we stand by one of the typical conical peat stacks, and gaze away across the warm, brown expanse of bog, to the distant purple of the gently swelling hills, over which great masses of cloud are passing in a glorious



HERE NATURE HAS USED RAIN AND LAND-SPRINGS
AS HER TOOLS.

pageant of endless form and colour, we are enthralled with the quiet beauty of the scene spread out before us. When at last we turn reluctantly away to continue our tramp across country, we carry with us a mental picture of the charm of that wild landscape which will return to us again and again through the years to come. These gently swelling lava plateaux over which we tramp are relics of volcanic activity which took place in a past geological age, called the Tertiary Period.

If we explore the cliffs towards the Giant's Causeway, we shall be able to trace the double structure of these ancient lava streams. On the storm-swept face of these cliffs of black-brown, volcanic rock, almost every alternate layer shows in the form of graceful six-sided basaltic columns. The layer above each zone of these columns represents the upper and more irregular portion of the ancient lava stream, while here and there we shall see some massive flows which have escaped

columnar division entirely. The Giant's Causeway is really the basal part of one of these lava streams, which we have seen in its entirety in the terraces of the cliff close by. As we look down upon the most worn portion of the Causeway, the surface presents the appearance of a titanic tessellated pavement, and we can easily understand how this wonderful example of Nature's masonry came by its name.

One cannot gaze upon those beautiful symmetrical columns, so uniform in shape, without marvelling at the forces which moulded them in the dim past of the Tertiary Period. Volcanic energy, great heat, and chilling air are the tools with which Nature has shaped these six-sided columns out of the lava streams; and wherever volcanic eruptions are taking place to-day, there these columns are being formed, just in the same way as those of the Giant's Causeway were formed in the lava flows of the Tertiary Period.

F. MARTIN DUNCAN.





"NOT HUNGRY, THANK YOU."

THE LONG-TAILED TIT

By A. J. R. ROBERTS, B.A.

Illustrated with Photographs by the Author

"CHURR, churr," in low, lover-like tones echoed a similar call, and a Long-tailed Tit—the daintiest ball of feathers imaginable—flew to re-join its mate, paused to gather a tiny morsel of moss or lichen, and then passed on. "Churr, churr," called the second bird, as though afraid of losing touch even for a moment with its newly-found partner, and thus they flitted from branch to branch and tree to tree, unwittingly leading me into the sheltered valley which they had made their home.

A swift woodland brook, sparkling and singing in tiny rapids over a gravelly bed, silent and shadowy in the deeper swirling pools, caressed the foot now of one, now

of the other of the twin hills that hemmed it in, as though unable to decide upon which to bestow its favours. On either bank the hills rose steeply, though to no great height, each well wooded, yet totally different in character. Facing east, an oak wood, bare as yet, carpeted with dead brown leaves, relieved here and there by a clump of primroses on long, slender stalks, seemed dark and mysterious by contrast to the sunny, smiling valley—a fitting haunt for the carrion crow, the hawk, and the owl which lived there and sallied forth to perform their deeds of darkness.

The other hill, flooded with the afternoon sunlight, was crowned by a coppice

of firs whose deep evergreen needles mingled with the tender shoots of larch, blushing with "rosy plumelets." A steep bank, ablaze with short-stemmed primroses, descended to the stream, throwing forward a spur as though to buttress it. The peninsula thus formed was a veritable tangle of woodland plants, and bramble and honeysuckle combined to guard the sanctuary for the small furred and feathered world that peopled it. Towering above the thicket, like forest trees above the jungle, rose a large clump of gorse, and it was to these bushes that the Long-tailed Tits brought the results of their foraging.

The nest had reached the cup-shaped stage, and the birds were engaged in heightening the walls preparatory to doming it over. The whole structure was beautifully woven, moss entwined with fine dry grasses, bound securely with spider's web, and adorned outside with lichens. As I watched, one of the old birds entered, disappearing from view except for an inch or two of tail; but

even without that guide I could follow the bird's movements by the heavings of the walls of its house, as the tiny architect turned round and round, pressing its breast against the sides so as to ensure its perfect symmetry. Then craning its head and neck over the edge, it rearranged some rebellious piece, added the fragment it had brought, and finally hopped out to sit close by, preening its feathers, while its mate took its turn, churring from time to time in sheer joy of the sunshine and the careless honeymoon days before eight or nine hungry mouths appear to make the business of life a grim reality.

Then off they flew together on a fresh journey, perpetually calling to and answering each other, returning with their spoils after some three or four minutes' absence, working incessantly at their labour of love, yet adding such minute fragments that at the end of some three hours' watching I could see no perceptible increase. Yet there was an increase. The walls were heightened, and some few



THE FAVOURITE OF THE FAMILY.

days later the nest was domed over, leaving an entrance hole at the side near the top. The framework was complete, compact, and springy, with a strength and resistance one would hardly credit. Then came the task of house-furnishing, and now the birds flew into the fir wood, whence from time to time I heard the whirring of wings of the pheasant, and it

with a flush of pink from the yolk, and each containing the wonderful germ of life. As incubation advances, the shells lose their transparency, becoming a dull white, yet doubly precious doubtless to the little mother. The early life of the tiny brood is less easy to picture, but it must resemble that of most other nestlings. Unable to count, the parent birds



HIS TURN AT LAST.

was easy to picture the Tits gleaning the feathers discarded by that dandy in his morning toilet. They were plentiful, too, judging by the frequency of the comings and goings; and they had need to be, for the softest of eiderdowns is not more soft than the interior of a Long-tailed Tit's nest. It is said that a naturalist has counted two thousand feathers in the lining of a single nest, and to one who has watched the untiring industry of the builders the sight of a nest torn out by some wanton vandal hand is moving almost to tears.

Then the eggs are laid—eight, ten, or even more—delicate, white prisons, faintly spotted with red at the larger end, suffused

have to feed their young in the dark, and it must be that the strongest, as ever in Nature, get the lion's share. Thus it is that some are fledged and leave the nest days before the others—or can it be that incubation is begun before the full complement of eggs is laid? In any case, as the young ones grow the nest would be strained to bursting were the walls any less firmly built. And yet the old birds enter, must enter to attend to the sanitary requirements of the brood. The excrement of all young birds in cup-shaped or domed nests is encased in a filmy sack, a wonderful provision on Nature's part to enable the parent birds to keep all sweet and clean.

Bad weather and other causes prevented my obtaining pictures of the birds entering or leaving the nest, and it was obvious that the young were nearly ready to fly; for, as I watched them one evening, I noticed that they climbed to the opening to receive the food. The next morning was gloriously bright, and I quickly had my camera set up with a few

themselves of its harmlessness. It was sufficiently entertaining to observe how perfectly they kept in touch with their scattered brood, invisible to me in the dense carpet of plants, and my ears and eyes were fully occupied in following the doings of the hundred and one other creatures abroad on that May morning. At last it occurred to me to wonder if *all* the

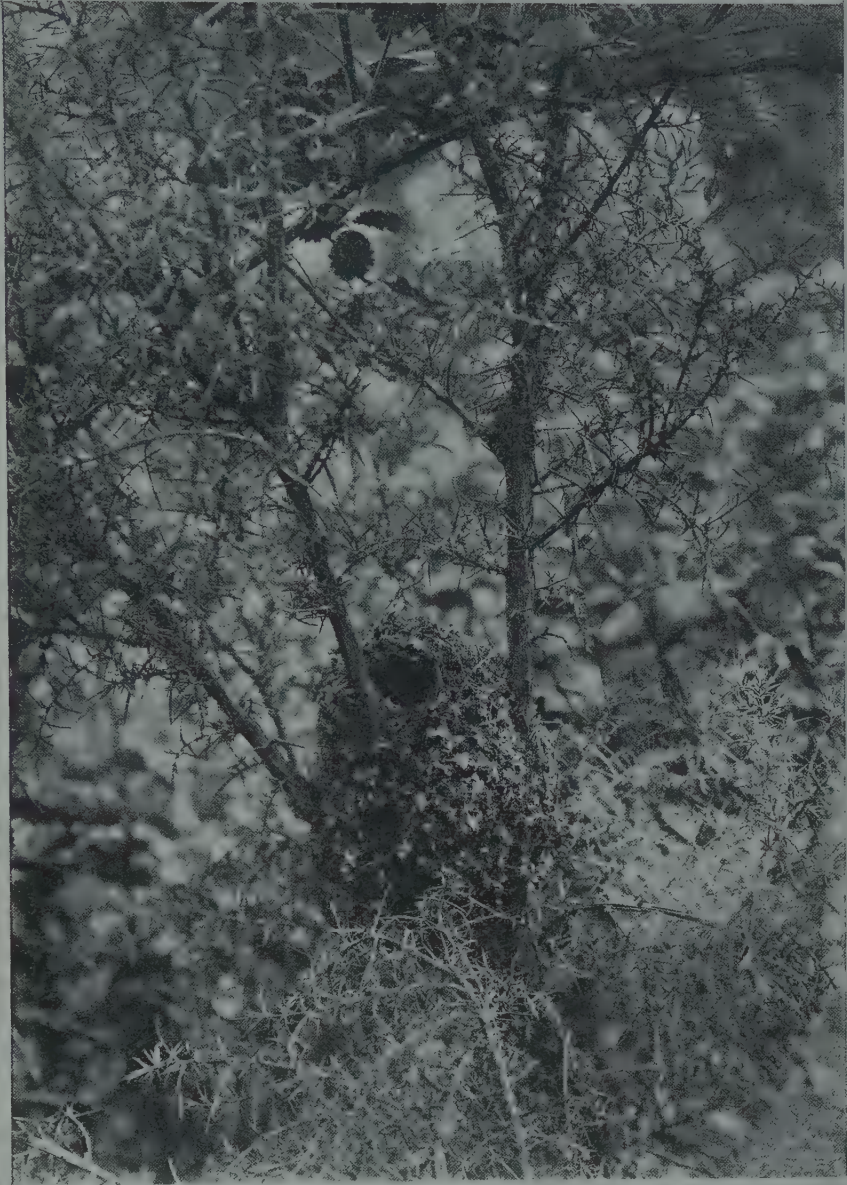


"CAN'T PLEASE EVERYBODY."

sprays of honeysuckle twined around it to mitigate its awe-inspiring appearance. The birds, confiding and trustful by nature, had become quite accustomed to my presence owing to my frequent visits, and it was as unnecessary as it would have been useless to attempt to conceal myself. I had not long to wait before the Tits returned with succulent green caterpillars, and from the indescribable tremulous cries proceeding from the undergrowth it was apparent that they were feeding some young ones that had already flown. An hour passed swiftly without any serious attempt on the part of the parent birds to approach the nest, though they examined the camera and convinced

brood had flown, and carefully feeling with one finger, I discovered that my camera was focused on the empty, deserted nursery.

The young ones could only have left the nest an hour or so before my arrival, for they were still far from proficient in the use of their legs. A careful search resulted in the capture of three fledgelings, which I placed on a spray of bramble, and readjusting the camera, I waited once more. Almost immediately the parents responded to the hungry appeals; but, hovering like humming-birds before a flower, they fed their young ones whilst on the wing. It was delightfully pretty to watch, but the light was not sufficiently



THE DESERTED NURSERY.

strong to permit of the rapid exposure which would have been necessary, so, transferring the fledgelings to a spray of honeysuckle, I arranged the bramble in such a way as to compel their parents to alight. It now occurred to one of the trio that he was wanted elsewhere, and, stretching his feeble wings in a venturesome flight, he paid the penalty of his rashness by falling into the stream. I was not aware that the old birds were in the neighbourhood at that moment; but nothing connected with the young seemed to escape their watchful eyes, and immediately they fluttered helplessly around, uttering cries of distress and alarm. It was the work of a moment to effect a rescue and replace the wanderer on the branch with his companions, but the incident had a lasting effect on the behaviour of the parent birds. From that moment they seemed to have absolutely no fear, and fed their young in perfect unconcern within four or five feet of me as I stood by my camera and obtained a series of pictures. The grace and charm of their movements were wonderful. No effort seemed to be needed as they circled around the tiniest twig, and the swing and balance of the tail imparted a finish to their gymnastic feats which is lacking in the other

Tits. One is conscious of the extraordinary strength of the leg muscles whilst watching the Blue Tit or any of its relatives, but the Long-tailed Tit leaves only the impression of graceful ease, concealing his art with the masterly skill of the true artist.

There was no apparent method in the feeding of the trio, and the behaviour of the old birds was an interesting comment on the shortness of bird memory. Even with the three young ones arranged in a row, they seemed to have no idea which they had fed last, and popped the food into the beak which yawned the widest. Once indeed—the only occasion on which I have ever seen it happen—both birds forced caterpillars down the throat of one young one at the same time and, contrary to one's usual experience, my camera happened to be ready.

At last the fledgelings grew tired of their inactivity, and fluttering off into the undergrowth, they made their baby attempts to imitate the movements of their parents; and apt pupils indeed they proved, for on the next day they had gone forth into the world beyond their peninsula, and soon flitted in company through the woods, playing a kind of follow-my-leader—the traditional game of the species.

A. J. R. ROBERTS.

SAND-DUNES

By F. MARTIN DUNCAN, F.R.P.S.

With Illustrations by the Author

SHOULD we explore the whole of the coasts of Great Britain, one of the features that would most quickly and surely attract our attention would be the almost universal presence of sand, even where only a narrow strip of shore is left to view at low tide. In the course of our explorations, we should also find that wide expanses of sand flank the shores for miles along many parts of the coast, frequently on the land side forming into a belt of low hills or

dunes, which in some situations rise to over one hundred feet in height.

If we scrape up a handful of sand from the shore and examine it, we shall find that it consists mainly of quartz grains, that are singularly uniform in size. "Where has it all come from? How has it been formed?" are questions that rise naturally in the mind, as we stand upon a wide expanse of sandy shore. The second is by far the easier question to answer, for the shore is the grindstone,



THE WIDE SWEEP OF A SANDY BAY.

and the waves are the power which Nature has used in the process of grinding down these countless sand grains. The granites, gneisses, and crystalline schists, wherever they form the coast-line, have contributed largely to the formation of the sands, though the denudation of the sea-cliffs under the action of the atmosphere, land-springs, and the waves cannot adequately account for the vast masses of sand to be found along our coasts. Probably a very large amount of the material, which in the course of geological ages Nature has converted into the golden sands that now fringe the sea coast, was originally transported shorewards from the hills and mountains by the glaciers and torrents of the Ice Age; and during the succeeding ages the *débris* so transported has been broken down, sifted, and distributed as sand and shingle by the waves.

It is very interesting to observe the characteristic difference of form which exists between the sands of the sea-shore and the sands of the great inland deserts. The sand grains on the sea-shore will always be found to retain to a certain degree their angles; and this

characteristic peculiarity is due to the wet grains lying with their faces to one another holding a film of water between them, which keeps the grains from actually touching each other, and consequently greatly reduces the friction between the sides of the grains, which would otherwise wear down the angles. On the other hand, the sands of the desert are absolutely dry and destitute of this protecting film of water, consequently they are blown about by the wind, and beating against, and rolling over, each other, become rounded, and finally converted into dust.

On the confines of the Isle of Purbeck, from the entrance to Poole Harbour to Studland Bay, stretches a wide expanse of beautiful sands, where one may spend a long summer afternoon collecting the many rainbow-tinted shells that have been left exposed by the gently lapping waves of the receding tide, or wander along the sands at, and above, high-water mark where the sand-dunes are forming, and where every stage in the process of their formation may be seen.

The factors that play the most important part in the formation of the sand-

dunes are the configuration of the surface of the shore, the nature of the rocks along the coast, the set of the tide, and the direction of the most prevalent winds. Indeed, the prevailing wind plays a very important part, for if it be one that blows on-shore, it dries and blows the sand left exposed by the receding tide inland; while a prevailing off-shore wind will blow the sand back into the sea, and so prevent the formation of sand-dunes.

The sand-dunes generally form a kind of natural embankment, separating the comparatively low ground inland from the shore proper. Very often this low land, from which the sea has been gradually shut out by the development of the sand-dunes, forms at first a brackish lagoon which, owing to the growth of aquatic vegetation, gradually becomes converted into a marsh; and this marsh-land is in turn slowly raised by the growth and decay of the water plants, until it eventually becomes drained, and forms an area of land capable of growing and yielding a rich harvest of corn.

The shore and land between Poole and Studland afford an excellent opportunity for the observation of this most interesting

process by which Dame Nature reclaims the land from the sea. During the spring tides, if we visit this stretch of the coast, we shall see a wide expanse of flat shore composed of beautiful firm sands. A soft, steady wind is blowing in-shore, and, helped by the hot rays of the sun, is rapidly drying the surface of the shore that has been left by the ebbing tide, and soon begins to drive the dried particles of sand landwards.

The shore slopes very gently upwards, and the drifting sand, as it is blown landwards, first passes over a perfectly smooth area up the slope until it comes to the inland margin of the shore, where the surface becomes more or less uneven, and is partially clothed by a scanty vegetation of sedges and grasses, and other plants. There, unless the wind is blowing a gale, the sand becomes heaped up amongst the stems of the grasses, and gradually, like drifting snow, fills up all the uneven depressions. Quite a superficial examination of many of the plants that grow along the inland sandy margin of the shore, comprising chiefly certain species of grasses, sedges, and the like, will reveal the fact that they are specially adapted



REEDS AND GRASS ARREST THE PROGRESS OF THE SAND.



THE SAND SILTS UP AMONGST THE GRASS STEMS.

to their environment, so that their roots mat and bind the sands together, and their stems are so shaped as to cause the sand to accumulate between them. Through the agency of these plants the drifting sands are arrested on their inland march, and, accumulating, become heaped up and formed into sand-dunes.

At the top of the shore the sand lies in low, loose mounds or hillocks, hardly worthy of the name of dunes, but as we follow them inland, they gradually increase in height, forming a series of miniature ranges of hills, each range running parallel with the shore, built up with graceful sloping curves seaward, and steeper and deeper valleys on the landward sides. The wind blowing the sand up the somewhat prolonged slopes on the seaward face of the dunes, tends to heap its burden at the top, from whence the higher currents of air seem to carry it par-

tially across the valley that separates one range of dunes from another.

Inland, beyond this belt of sand-dunes, we come upon a narrow strip of heather-clad land which gently slopes downwards to the reed-bordered margin of a beautiful lagoon called the Little Sea. Standing on the summit of the highest range



THE SAND IS BLOWN UP THE GENTLE SLOPE OF THE SHORE.

of the sand-dunes at the hour of sunset, and looking landwards, the scene presented to our view is one of extraordinary and romantic beauty. At our feet lies the lagoon or Little Sea, its still waters reflecting all the glowing glory of the sunset sky. On its further margin the land slopes upwards into gently-swelling, heather-clad hills, which trend away into the purple distance where rise the beautiful Purbeck Hills. As the great ball of the sun slowly sinks in the west, the waters of

Three Queens with crowns of gold—and from
them rose

A cry that shiver'd to the tingling stars,
And, as it were one voice an agony
Of lamentation, like a wind, that shrills
All night in a waste land, where no one comes,
Or hath come, since the making of the world."

For a while a great silence seems to wrap us round, as the twilight deepens into dusk. A silence that fills the heart with a deep feeling of reverence, and of gratitude for the gift of life. We seem



THE DUNES RISE HIGHER AND HIGHER.

the Little Sea take on a wondrous silver sheen, and as the first cool breath of the evening wind caresses our cheek, it brings the soft, sad, wailing cry of the wading birds. It seems as if we stood upon the margin of some enchanted lake, of such a lake as that to which the brave Sir Bedivere carried the dying king. Again, the wailing cry comes down the wind, and Tennyson's beautiful lines, instinct with life, rise to our lips :

"And on a sudden lo! the level lake,
* * * * *

Then saw they how there hove a dusky barge,
Dark as a funeral scarf from stem to stern,
Beneath them; and descending they were ware
That all the decks were dense with stately
forms

Black-stoled, black-hooded, like a dream—
by these

to draw nearer to Nature, and to better understand the marvel and beauty of her work, to dimly realise something of that mysterious all-pervading Power, which by the work of tide, wind, and vegetation, has during the march of centuries formed the barrier of the sand-dunes.

As we turn homeward along the sands, the great silver disc of the moon rises and shines across the quiet bay now filled with—

" . . . such a tide as moving seems asleep,
Too full for sound and foam."

Silvery white stand out the sand-dunes against the deep blue of the evening sky, their miniature valleys filled with dim mysterious shadow.

F. MARTIN DUNCAN.



CHAPTERS IN PLANT LIFE

IV—THE PLANT AS A PARENT

By S. LEONARD BASTIN

With Photographs by the Author

THE first duty of the individual, and one even more important than the preservation of its own life, is the perpetuation of the race. It is easy to think of the care which the animal bestows on its offspring, the food and protection which the parent provides, the fostering of the new generation for its advent into a world of strife. We are not so prone to regard the plant as a parent, responsible for the reproduction and outfitting of its kind. Yet the members of the vegetable kingdom take many extraordinary precautions to ensure the well-being of their progeny, and the study of these forms a very fascinating chapter in the book of Nature.

In the present instance it is not proposed to enter into the wonders of the

floral marriage, but to presume that the ovary has received the touch necessary for its development, and that the seed is an accomplished fact. Now a seed has never, perhaps, been better described than as a tiny plant wrapped up in a packet of food material. Cutting through the protecting skin of a bean, it is found that the seed easily splits up into two pieces. Between these two cotyledons, as they are called, we shall find the germ—a perfect little plant in which all the parts are plainly discernible, though on a diminutive scale. In the case of the bean, in common with many dicotyledonous plants, the supply of starch for the use of the young plant is absorbed into the cotyledons. The very large number of seeds possessed of only

one cotyledon carry the supply of food material in a separate store, which is spoken of as the albumen. The substance set aside for the nourishment of the seedling is sufficient to give the plant a good start until it is able to set up house-keeping on its own account.

The seed has been endowed with a marvellous vitality. If the conditions are not suitable for its development it can very well wait until the circumstances are more favourable. Thus, it is seen that the seeds which fall to the ground in the autumn do not, as a rule, germinate until the following spring or summer. Well authenticated instances are on record where seeds buried deeply in soil have remained in a state of suspended activity for many years. Finally, when digging operations have brought them more near the surface, they have readily germinated, apparently little the worse for their long confinement.

Granted certain conditions, the seed will speedily show signs of development. Warmth, moisture, and the presence of oxygen soon stir the sleeping embryo into life, and bring about the wonderful changes connected with the birth of the plant. Heat is necessary for the forwarding of all vital processes; moisture is required for the conversion of the nutrient into a fluid state, whilst oxygen is necessary in order to bring about the change of the starch into sugar, in which form it can be assimilated by the plant. In a chemical sense, starch and sugar are not widely different, save that the former contains an additional proportion of carbon. The absorption of oxygen by the seed sets free the carbon, and thus changes the composition of the food supply. At first sight it may seem strange that in the beginning sugar was not stored away in the seed. It is a wise provision

that has ordered it otherwise, for had sugar been deposited in the first instance it would almost certainly have undergone fermentation. In this condition it would, of course, have been useless for the nourishment of the little plant.

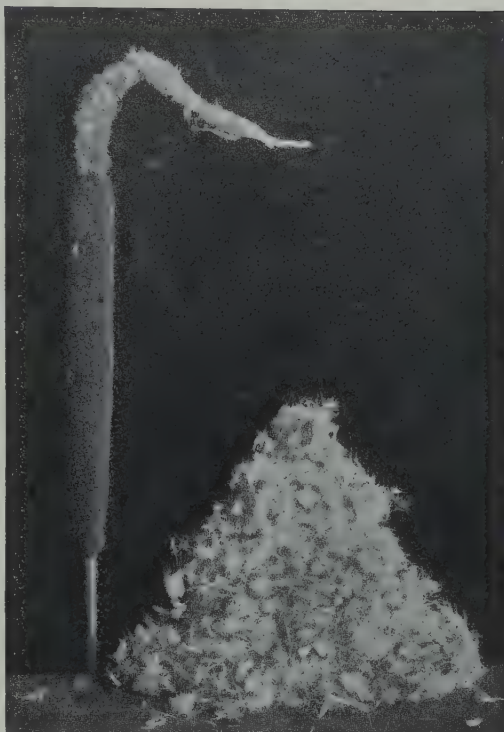
The most obvious change in the appearance of the seed when conditions favourable for its germination are present, is a decided increase in size. This goes on apace until the outer skin bursts, and two very distinct parts are to be seen. One, whitish in colour and sometimes branched, sinks at once into the soil—this is the root; the other, of a light green shade, rises above the ground—this is the shoot. In the germination of the seed we are witnessing a phenomenon which has provided the puzzle of the ages. What is it that induces the radicle with such persistence to plunge into the soil? However the seed may have been placed when it germinated, the root always wriggles round so as to strike



SEED OF THE ELM IS SURROUNDED BY A WING-LIKE EXPANSION.

straight downward. Seeds which have been continually turned go through the strangest contortions in order that they may anchor themselves in the ground. It might be thought that it was the desire of the roots to get away from the light, had it not been shown that seeds grown in a box with holes in the bottom will send their radicles down through the openings out into the open. In doing so they leave not only the darkness behind them, but also the moisture in which they germinated.

It has been suggested, and with a good deal of reason, that the law of gravitation has not a little to do with this strange tendency on the part of plants. Years ago a president of the Royal Horticultural Society, Mr. J. A. Knight, germinated bean seeds on the rim of a vertical wheel, which was always kept revolving. Arrangements were also made to keep the seeds in a moist condition favourable to growth. It was found that the roots of the seedlings now grew outwards away from the centre of the wheel. From this it would appear that when the action of gravitation was overthrown by the centrifugal force of the



THE SEEDS OF THE BULRUSH ARE CARRIED TO GREAT DISTANCES BY THE WIND.

It is computed that the head of the bulrush contains as many as a million seeds.



THE DANDELION IS TYPICAL OF THE FLYING SEEDS.

revolving wheel the little plants were influenced by the new power. Thus it seems to be evident that the influence of gravitation in directing the course of the roots of seedlings is considerable. This does not by any means offer a complete solution of the problem; for whilst the root goes downwards the shoot with almost equal precision directs its growth upwards. It must be admitted that there is something more than a mere mechanical influence at work. We are indeed brought face to face with one of those mysteries which are as inscrutable as life itself. The most that can be said is that the radicle of the seedling is endowed with a geotropic tendency which impels it to bury itself in the earth, the tendency of the shoot meanwhile being in an opposite direction. As to the underlying causes of the happenings we are in complete ignorance.

Whilst the radicle of the seedling must always grow downwards, such is not the

case with the secondary roots. These spread out laterally, and, indeed, can be induced to develop in an entirely opposite direction to that taken by the initial root. Thus, even if the radicle of the plant is injured in such a way that it cannot develop, the branch roots speedily come to the rescue. The seedling has indeed been endowed by Nature with extraordinary energy, and frail a thing as the little plant appears to be, it is not easily killed. Even if the plumule happens to be broken off altogether, this is speedily replaced by a fresh shoot, and the plant emerges on the scene but little the worse for the accident.

Throughout its life history the average plant is chained to one spot. It flowers, perhaps produces its seeds, without difficulty, and yet there still remains a problem which is by no means easy of solution. In certain circumstances the parent plant may be the greatest enemy of its own kind. The very fact of its

continued existence after fruiting may form a serious menace to the well-being of its offspring. The seeds which fall on to the ground surrounding a perennial come up to find a well-established plant already in possession of the field—when their chance of arriving at maturity is exceedingly remote. There is no room for apprehension of this kind on behalf of annual plants, and it is curious that, generally speaking, the provisions for wide seed distribution of these species are not so pronounced as in the case of perennials. It is a very different matter with plants which live for more than a year, and many ingenious devices have been brought into being to ensure the scattering of the offspring over a wide area.

Some of the most beautiful arrangements to secure the passage of the seed are evidenced in those which are designed to be carried hither and thither by the wind. A vast number of seeds produced



THE RADICLE WILL TWIST IN A STRANGE MANNER WHEN THE SEED IS TURNED DURING GROWTH.

by the composite plants are contained in vessels provided with appendages to enable the processes to float away on the breezes. These devices reach their perfection in the various members of the Thistle family, which surround their seeds with the most perfect flying apparatus imaginable. Anyone who has watched a clump of Thistles on a breezy autumn day must have marvelled that the whole world has not long since been crowded out by these aggressive weeds. Every puff of wind raises the downy seeds from the plants, and away they go scudding over the country until they settle in some situation from which they cannot escape. The seed vessels of the Thistle often rise to a height of thirty feet in the air, and when at this elevation it is not unreasonable to suppose that they travel a mile or more before finally settling down.

Following after the Thistle there is a whole host of plants producing seed vessels which have tufts or crowns of hair as attachments. The pretty little parachute-like device of the Dandelion seed, the hairy tufts of the Willow Herb and Bulrush vessels, all materially assist in the dispersal of the plant's progeny over a wide area. A little plant, common enough in some meadows, known as *Thrinicia hirta*, produces two kinds of seeds; one is provided with hairy appendages, the other is not. The former are specially adapted for travelling over a considerable distance, whilst the latter are for the perpetuation of the species nearer home.

The seeds of many trees, although they cannot rival the length of flight accomplished by the Thistle, are by means of their formation wafted to a considerable distance. If the fruit of an Elm be examined a curious wing-like expansion is found, which when a moderate breeze is blowing enables the heavy seed to float away from its parent. In common with those of the Maple, the Sycamore seed vessels go round and round, and thus retard the rapidity of their fall to the ground. The golden long-stemmed blossoms of the Lime are developed with a green bract, and this appendage remains until the late summer. When the ripening of the seed has come about the whole process is detached from the tree, and as

soon as it is in the air the use of the bract becomes apparent. The seed capsules are heavy, and pull the device into an upright position, in which state, as it falls, it commences to revolve with amazing rapidity. This induces a very leisurely fall, and, of course, all the while the process is sinking it is being carried farther afield by the breeze. The small seeds of the Birch and the Elm are surrounded by a membranous expansion which, as the vessels leave the tree, catches the wind and away they sail—not to settle down, perhaps, until they are some hundreds of yards away from the starting point.

Not a few plants rely upon water as the means by which their seeds are distributed. The strange double Coco Nut, the fruit of a Coco Palm, was a tremendous puzzle to early navigators, who very often found specimens floating in the sea many miles from the nearest land. The question was not definitely settled until the discovery of the Seychelle Islands, when the palm bearing the nuts was identified, thereby clearing up a great mystery. It is by ocean currents that the common Coco Nut has been distributed so widely among the Pacific islands. Almost the first tokens of vegetation on the coral reefs are the Palm trees, which appear on the smallest patch above high-water mark. The preparation of the Coco Nut for its long sea-voyage is a matter to which the plant has given special attention. In the first place the embryo and supply of food material are encased in a singularly dense shell, but outside of this is an enormous fibrous mass completely enveloping the nut itself. The distance over which these seeds will float is extraordinary, and were it not for the limited climatic range the species could not fail to have been established all over the world long ago. It is a well-known fact that seeds of various plants indigenous to the West Indies are not infrequently found on the north-west coast of Norway, where they have been swept round by a branch of the Gulf Stream.

In Britain the movements of water-borne seeds are to be observed in the case of many plants which grow on the banks of rivers or streams. The charming Snowflake, a plant which is probably not

a native, spreads amazingly by means of its seeds; these are encased in a capsule which readily floats. On the Loddon, a tributary of the Thames, the species has spread up and down the stream amazingly, and it is gradually extending to the main



THE SEED CASES OF THE MARTYNIA.

stream. As years go by it is likely that the Snowflake will become increasingly plentiful, until it is distributed throughout the Thames water-system. An astonishing illustration of the distribution of a plant by water is that afforded by the American water-weed *Elodea Canadensis*, a species which somehow was introduced into Britain about sixty years ago. In this short while it has managed to spread over most of the water-ways of Great Britain. Indeed, in many districts the plant has blocked canals to such an extent that it has proved a real hindrance to navigation.

The number of seeds which are dis-

tributed by animal agency is immense. All kinds of devices are adopted to secure the conveyance of the seed from its parent to a distant situation where it will stand a reasonable chance of securing room for development. Those seeds having hooked

vessels exhibit a variety of method which is amazing. Some, like the *Martynias* of America, are provided with hooks many inches in length; these seize hold of any passing animal as it plunges through the forest, becoming deeply embedded in the flesh, and the victim will perhaps travel several miles before it can divest itself of its painful burden. Even more formidable still is the seed vessel of the South African Grapple Plant (*Harpagophyton procumbens*). These roll about over the dry plains, and as they are provided with a large number of curved hooks, readily attach themselves to the coats of animals. Indeed, it is said that they have even been known to cause the death of lions. Finding some of the seeds attached to its skin, the animal endeavours to tear the cruel hooks away, with the result that it gets one of the vessels hopelessly entangled in its mouth, and so perishes in a most miserable fashion.

Many of our British plants produce seeds provided with hooks, although these are nothing like as formidable as the two foreign species described above. Indeed, the seed vessels of the Agrimony, the Cleavers, and the Burdock are really objects of great beauty. That the processes serve their purpose admirably is well known to anybody who has taken a walk in a field at seeding time. One's garments become quite thickly covered with the seeds, which hold on with great tenacity. From this it is easy to get an idea of the distance to which many of these may be carried whilst clinging to the coat of some wild creature.

A very large number of plants are able to surround their seeds with a pulp which is attractively flavoured. It is certainly

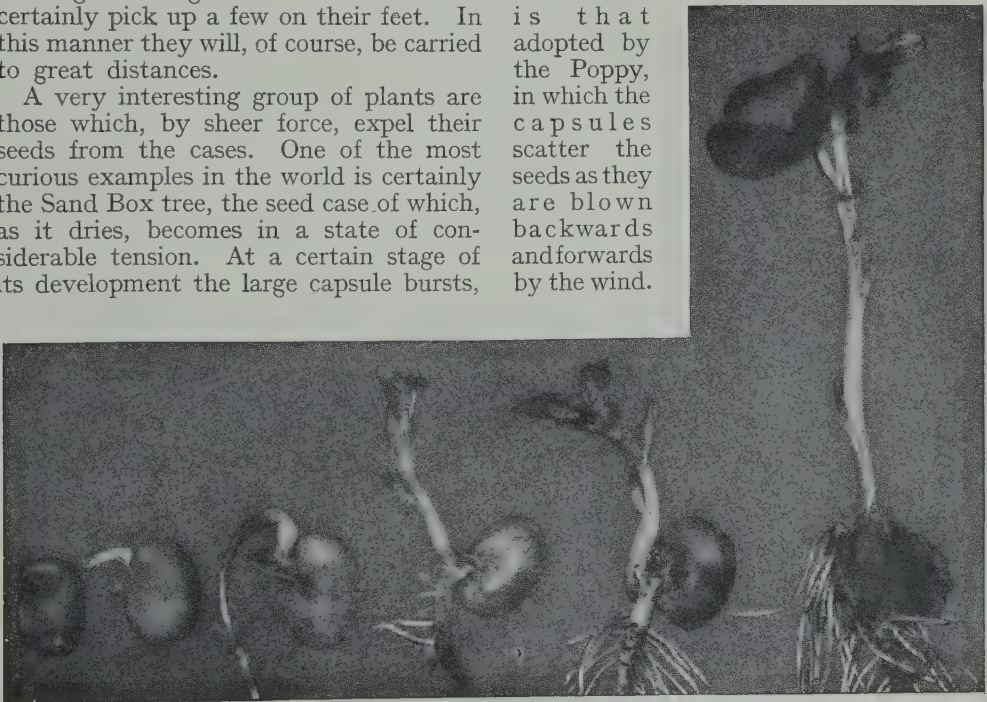
a curious fact that just at the time when the seeds are ready for dispersal the fruit or berry becomes a bright colour, as if the plant were anxious to attract attention to its progeny. In many of these cases the seed is protected by a hard covering that is quite unaffected by the digestive juices of any animal which should happen to swallow it when feasting on the fruit. It is not always that the seeds of fruits and berries are swallowed by the bird or animal acting as the distributing agent. It has been noticed elsewhere that the seeds of the Mistletoe are frequently carried about on the beaks of thrushes. Many of the seeds, such as Chestnuts, Beech-masts, Acorns, which are edible in themselves, are destroyed in large numbers by the animal life of the country. On the other hand, owing to their value as food, a large proportion of them will be carried to considerable distances by squirrels and other creatures, and perhaps dropped, or stored away and forgotten altogether. In a slightly different way enormous numbers of seeds which are eaten by birds rely for their dispersal on the fact that whilst feasting the winged creatures will almost certainly pick up a few on their feet. In this manner they will, of course, be carried to great distances.

A very interesting group of plants are those which, by sheer force, expel their seeds from the cases. One of the most curious examples in the world is certainly the Sand Box tree, the seed case of which, as it dries, becomes in a state of considerable tension. At a certain stage of its development the large capsule bursts,

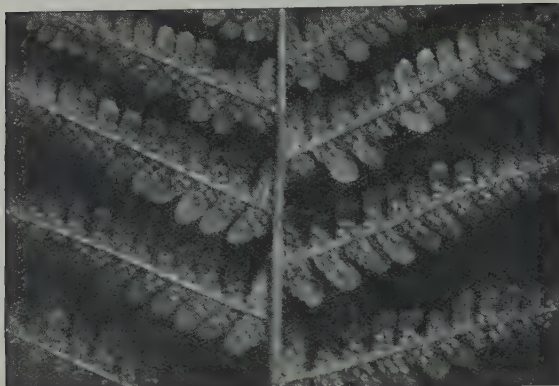
hurling the hard seeds with great force in all directions. It is said that passers-by have not infrequently been injured by the flying seeds. In much the same way the Para Rubber tree scatters its seeds afar, and when these are ripening in a plantation the sound resembles the constant firing of pistols. To come to more homely instances, the common Balsams of our gardens possess seed vessels which are veritable popguns. When the seeds are ripe for ejection the five divisions of the capsule burst open and throw out the contents with a good deal of violence. The pretty little English Wood Sorrel offers another example of those plants which scatter their seeds with force. As soon as the seeds are ready for dispersion the capsule splits open, and the strong tense tissue covering the seeds being suddenly ruptured, throws them to a considerable distance.

Not a few of the pod-bearing plants contrive to have their seeds scattered afar by means of their legumes, which, when dry, curl up in spiral fashion and so eject their contents. A very simple device

is that adopted by the Poppy, in which the capsules scatter the seeds as they are blown backwards and forwards by the wind.



THE NORMAL DEVELOPMENT OF A BEAN.
The shoot goes up and the root goes down.



PATCHES OF SPORANGIA ON BACK OF MALE FERN.

Even with this arrangement the distribution covers a much wider area than might be thought possible. A strange form of seed dispersion is that to be seen in the case of the Earth Nut (*Arachis hypogæa*). The singular part about this plant is that, as the seeds begin to ripen, the pods are forced below the surface of the soil through the lengthening of the flower stalks, and are in this way actually planted. The same method has been adopted by the Sweet Violet, and also in the case of a few other plants. The phenomenon is certainly rather a puzzling one, for the behaviour of these species can scarcely be said to aid in the wide dispersal of the plant. In some of the instances which possess this strange habit, there are, in addition to the subterranean pods, aerial ones which bear their seeds in a more ordinary manner. We may suppose that the seeds which are so carefully sown by the plant are put into position in order to make quite certain that the species shall continue to hold its own on that particular spot.

The large number of plants which do not produce flowers make comparatively little provision for the welfare of their offspring. The early observers were much puzzled as to how it was that Ferns which appeared never to produce seed were able to increase their kind. It was not until the coming of the microscope that the strange life history of the Fern was understood. An examination of the brown patches to be found on the back of many Fern fronds shows them to be groupings of strange little stalked cases, called

sporangia. At a certain stage in their existence these sporangia burst open, and scatter their contents to the winds of heaven. This matter is formed of numbers of individual grains, in form varying largely in the different species. These spores are very different in their formation from the seeds of flowering species; each one is little more than a speck of life in an elementary form.

Although the process of development from the spore to the Fern plant varies considerably, a typical case may be briefly outlined. Being very light, the spores float away on the slightest breezes and a certain number of them are sure to find a resting-place on some moist patch of soil. It is not very long after the lodgment of a spore that a change takes place, which by a process of cell extension results in the production of a heart-shaped green film in measurement about an eighth of an inch. After an interval, two very distinct kinds of cells begin to put in an appearance upon the under-side of the prothallium. These represent respectively the archegonia, or germ cell, and the antheridia, or sperm cell. At a certain stage in the history of these cells, thread-like processes, known as antherozoids, emerge from the sperm cells and enter the germ cells, and thus bring about the fertilisation of the embryo. Soon after this has been accomplished the prothallium and all its system of cells dries up, leaving behind only the fecundated germ. Yet another change, and the tiny frond struggles upwards, and the birth of the Fern is an accomplished fact.

THE TEASEL

By BENJAMIN HANLEY

With Photographs by the Author

WHEN seen in full flower the Wild Teasel (*Dipsacus sylvestris*) is a striking plant. It grows to a height of six feet or more, and the larger flower heads will measure as much as four inches in length. The flowers, mauve coloured, prove a great attraction for bees; indeed, there is an old Yorkshire saying which likens a crowd of people to "bees round a Teasel (or 'Tazzle') field."

The flowers commence to open out—not, as might be expected, at the base of the head, but half-way up, and then proceed in two distinct circles, one upward, the other downward.

The Fuller's Teasel (*Dipsacus fullonum*), formerly largely used in cloth dressing, was derived from the Wild Teasel. The photographs here given show the difference between the two flower heads. The bracts which remain after the flowers die are straight in the wild plant, and not very stiff; but in the cultivated variety these are hooked and possess just the stiffness requisite for raising the nap of cloth without tearing it, and so large tracts of land were given over to the Teasel-growing industry.

The seeds, which are about a quarter of an inch in length, and very narrow, were sown broadcast in March or April, and the plants did not reach maturity until after a period of eighteen months. When fairly above ground the young plants underwent a process of "slinging"—i.e. the best plants were left growing about a foot apart and the rest rooted up along with weeds and rubbish. For this singling out a specially made spade was used, the blade being about eighteen inches in length and four

or five in width, with a wooden handle curved outward so as to be well clear of the plants when in use.

May or June the following year the plants began to flower. The leaves are united at the base and form a kind of cup, which is nearly always filled with water, whether there has been any recent rain or no, the cup so formed by the two lowest leaves often holding considerably over a pint of liquid. If the rain had been recent this was often utilised by the hardy sons of the soil to quench their thirst.

In September, or nearly eighteen months after being sown, cutting operations began, sometimes the "hands" being engaged by the day at a stated wage and



DRIED FLOWER HEAD OF FULLER'S TEASEL
(*DIPSACUS FULLONUM*).



DRIED FLOWER HEAD OF WILD TEASEL
(*DIPSACUS SYLVESTRIS*).

at other times by piecework, the latter being by far the more profitable to an experienced cutter. The flower-heads were cut off about eight inches from the top, and the upmost heads, known as "kings," presumably on account of their superior size, were made up into bunches of forty; the next in size, termed "maidens," and the least of all, "buttons," being tied into bundles of fifty.

It is said that an experienced worker could cut as many as twenty thousand per day. The rate of pay was threepence per thousand.

When engaged in cutting, the operators wore a kind of waterproof smock to save their clothing from being drenched by the water collected at the base of the leaves and the sticky sap which exuded from the cut stalks. When finishing work this overall looked as if it had been given a coating of glue.

As the stalks are somewhat prickly leather gloves were worn to protect the hands, and the cutting operation itself was performed by the aid of a knife specially made for the work, the blade being two to three inches in length, slightly tapering, and somewhat turned up at the point.

As the heads were made into bundles, they were hung on the old plants to dry for two or three days, and then strung on to long poles and carried to open sheds or "helms" erected in the fields for the purpose, there to undergo a further period of drying, which occupied several weeks. This at length completed, the bundles of heads were fastened round staves about three feet long by the aid of willow saplings, until they looked something like a circular brush. This done, they were despatched to the mills.

Any flower heads found blooming during the cutting season were termed "widows," and as the bracts were soft they were left on the plants, to be afterwards cut down along with the stubble, gathered into heaps, and burnt.

The demand for Teasel heads for cloth dressing is not now very extensive, and therefore the cultivation of this plant has gradually diminished year by year until now one cannot find many acres where formerly most of the land in the district was utilised. It is without doubt a dying industry; nevertheless, as one travels up and down the country, old sheds may be noticed which formerly were used for drying heads, the sides being composed of Teasel stalks tied together in faggots; and in most villages one may enjoy hearing related by some old worthy many interesting features and incidents connected with the cutting of the "Tazzle." From such an one the facts here given were elicited.

BENJAMIN HANLEY.



